# SHORT WAVE RECEIVERS FOR THE BEGINNER

DATA BOOK SERIES No. 14

6/-

JK WORSLEY 00062

# SHORT WAVE RECEIVERS

## for the

# BEGINNER

DATA PUBLICATIONS LTD
57 Maida Vale London W9

First Edition, November 1959

Second Printing, April 1960

Revised Edition, June 1963

Second Printing, June 1966

© Data Publications Ltd., 1963

# Contents


Preface ... ... ... ... ... ... ... ... 4

Introduction to the Short Waves, by Frank A. Baldwin. ... ... 5

(*Radio Wave Propagation Conditions, The Aerial and Earth, The Broadcast Bands, Identifying Broadcast Stations, The Amateur Bands, CW or Phone? Clubs and Societies, QSL'ing, Receiver Calibration, Operating your Short Wave Receiver*).

Soldering Notes ... ... ... ... ... ... ... 16

Beginner's Short Wave Receiver ... ... ... ... ... 17

(*1-valve battery receiver, switched coils, covering 4.7 to 21 Mc/s*).

Adding an Audio Stage to Beginner's Short Wave Receiver ... ... ... 23

(*2-valve battery receiver, Brimar 1T4 and Mullard DL96 valves*).

Simple All-Wave Receiver ... ... ... ... ... ... 27

(*2-valve mains receiver using 6SL7GT and 6V6GT valves, separate power pack using 5Y3GT rectifier*).

Simple All-Wave Receiver, Part 2 ... ... ... ... ... 33

(*2-valve receiver using 12AT7 and 6BW6 valves, separate power pack with EZ41 rectifier*).

Resistor Colour Code ... ... ... ... ... ... ... 37

The "Meteor" Mini-Receiver ... ... ... ... ... ... 38

(*2-valve receiver which may be constructed as a 1-valver in first instance. Denco (Clacton) Ltd. plug-in coils and the Mullard EF41 and EL42 valves are featured*).

The PU1 Power Unit ... ... ... ... ... ... 45

(*Metal rectifier power unit for use with the "Meteor" Mini-Receiver*).

The "NIGHTRIDER" Communications Receiver ... ... ... ... 50

# Preface

IT IS PROBABLY TRUE TO SAY THAT MOST radio enthusiasts began with the construction of a simple 'straight' receiver. In recent years, with the vast increase of newcomers into the hobby, the trend for simple but efficient receivers, operating over the short wave part of the radio wave spectrum, has become quite noticeable. With the subject of radio now a part of many schools' curricula, interest has grown apace among the younger generation, and it is for them that the present book is primarily intended, containing, as it does, a varied selection of circuits to suit most tastes, individual preferences and capabilities. Both battery- and mains-operated receivers are included. Five receiver designs are fully described, and the instructions are complete with point-to-point wiring diagrams, circuits, illustrations and data. In some instances the construction of these receivers is carefully described, step by step, so that even the rawest beginner will have no difficulty in constructing them.

The last design featured in this book is the *Nightrider*, a superhet receiver built to communication standards that may be constructed in the first instance as a 5-valve or a 7-valve receiver depending upon individual preference and capability. This receiver is fully described in all respects except that no point-to-point textual instructions are included, it being assumed that the intending constructor is sufficiently advanced to undertake such a constructional project.

The price range of the equipment described varies from a few shillings to the outlay of several pounds, depending on the components already to hand—it being for the reader to choose which design is most suited to the depth of his pocket. In any event, three of the designs offered may be built one stage at a time, and the remaining stages may be constructed as time and/or available cash permit. All the components specified are easily obtainable at the time of going to press.

An introductory chapter has also been included for the benefit of those not conversant with short waves and for those who wish to gain the greatest benefit from their new hobby.

Several of the designs featured were originally published in *The Radio Constructor* and have proved so popular that an elaborated description of them seemed desirable.

It is my earnest wish that many who read these pages will find in them not only much of interest, but also the receiver design that, when completed, will introduce them to the short waves and many happy hours of world-wide listening.

Frank A. Baldwin.

# INTRODUCTION TO THE SHORTWAVES

*By* **FRANK A. BALDWIN.**

TO THE BEGINNER, THE SHORT WAVE spectrum represents a whole vast unexplored world—a world in which no frontiers exist, no passports are needed and no visas are required. With the aid of a very simple receiver, the beginner is able to explore this new world and to reach into the uttermost corners of the globe. To the new short wave listener, enthusiastically tuning his receiver for the first time, such faraway places as Pernambuco, Nairobi, Karachi, Rangoon, Goa, Peking and Wellington are likely, given favourable conditions, to burst upon his ears, with their short wave radio transmissions reaching him over many thousands of miles of land and sea.

In order that the utmost enjoyment may be obtained from his new-found hobby, some knowledge of the characteristics of short wave radio waves is necessary. This knowledge is also essential if the best results are to be had from one's receiver. To assist the beginner, the following general notes are offered for his guidance.

**Radio Wave Propagation Conditions**

These vary greatly on the short waves and are much like the proverbial British weather —sometimes conditions are good and sometimes they are extremely bad! Although it is not part of our purpose here to fully discuss the causes of these varying conditions, it may be briefly said that these variations in reception are caused in part by the ionosphere, which is an electrified zone surrounding the earth's globe, rising and falling in height with the time of day and the seasons of the year. There are a number of these zones or layers in the ionosphere, which have the property of reflecting some of the shorter radio waves back to earth. They occur at heights varying between about 70 to 200 miles above the earth's surface. The layers themselves are regions of strong electrification, or 'ionisation' as it is called—hence the name of the zone. This ionisation is caused by the action of some of the sun's rays on the rarefied outer gases of the earth's atmosphere. As a result of the reflecting properties of these layers, a suitable radio wave sent out from a transmitter at one place on the earth's surface will travel upwards and outwards towards the ionosphere and, on reaching this, its course will be changed and it will be turned back again towards the earth, arriving at a point many hundreds of miles away from the original place of transmission. The amount of bending which takes place in the ionosphere will depend on a number of factors; the wavelength of the radio wave and the electrical density of the ionosphere are two very important ones, and the actual height of the layer above the earth's surface is another very vital one. The density of ionisation and the height of the layers depends on the characteristics of the rays from the sun and cannot (at least, as yet) be influenced by anything man himself can do. The wavelength or 'frequency' of the radio waves can of course be altered by the engineer responsible for the radio transmitter, and it is up to him to choose a suitable frequency which—bearing in mind the ionospheric conditions at the time—will undergo just the right amount of "bending" in the ionosphere to bring them down to earth again at the place to which communication is desired.

Figure 1 shows a short wave radio signal leaving the transmitter, entering the ionosphere and returning to earth at a distant point. In addition to the part of the wave which travels up to the ionosphere, part of the transmission travels close to the ground and can, of course, be picked up by a receiver sufficiently close to the transmitting station. This part of the transmission is termed the 'ground wave'. It is rapidly attenuated by such objects as trees, buildings, undulations of the ground and so on, so that it soon becomes too weak to be heard. Between the place where this ground wave is no longer receivable and that where the reflected wave becomes detectable is a blind area in which no signals will be heard from the transmitter.

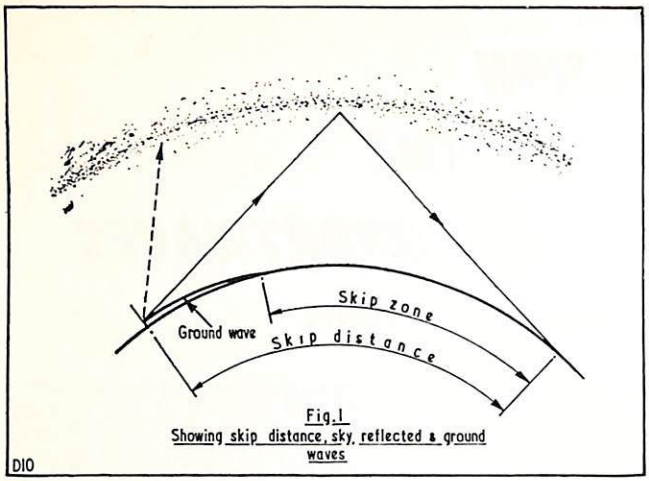
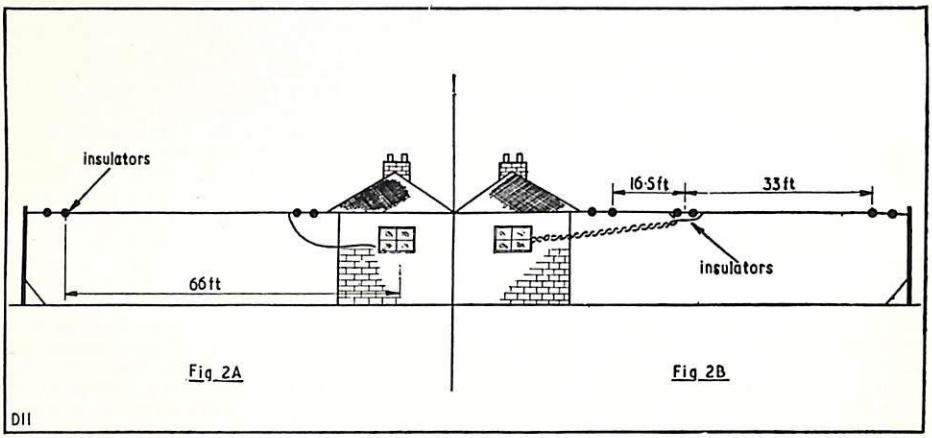



Fig. 1
Showing skip distance, sky, reflected & ground waves

The distance between these limits is known as the 'skip distance.'

The changes in the ionosphere are very closely related to visible activity on the sun. Sunspots and solar flares have been observed to closely precede fluctuations in radio propagation conditions and a whole science of "ionospheric conditions" forecasting has been gradually built up, so that nowadays the radio propagation engineer has a mass of data available from which he can determine the most suitable frequencies to use at any particular time in order to communicate with any specified part of the world.

Solar observatories, ionospheric sounding stations and scientific establishments specialising in this type of work all take part in this forecasting service and, whilst reasonably reliable results are possible, there is much further research yet to be done. The most important of the sun's variations, from the radio point of view, occur over a period of approximately eleven years, so that we find a gradual change in propagation conditions taking place during this cycle. During this period, conditions vary from exceptionally good to very poor. One of the fascinations of short wave listening is that what one hears is not only determined by factors on the earth but by happenings outside it. One of the characteristics of short wave radio signals is that they rise and fall in strength. This is brought about by the continuous fluctuation of the ionosphere which all the time reflects the waves in an ever-changing manner. Referring again to Fig. 1, it will be noted that it is possible for the listener to be situated at a point in the skip distance, in which case he will hear nothing from the transmitter. Due to the variations outlined above, the skip distance will be constantly changing to a greater or lesser degree, so that on the further side the signals gradually grow in strength, reach a maximum, and slowly fade away, this process being repeated over and over again.




*"Inverted L" Aerial* | *Double "Inverted L"*

**The Aerial and Earth**

The aerial is one of the most important items of the receiving equipment, although this is often overlooked by many beginners. If the aerial is a poor one then, generally speaking, the results obtained with any receiver will be correspondingly poor. The purpose of the aerial is to collect the tiny signals received from various transmitters and feed them into the receiver, where the required signal is selected, amplified, rectified, amplified again, and fed into the headphones or speaker. To do this efficiently, the aerial should be erected as high as possible, well in the clear from metal gutterings, etc., and have a good feeder or 'down-lead' into the receiver input terminals.

There are, of course, many differing types and styles of such aerials; but the one recommended for the beginner is that shown in Fig. 2A. In this, the aerial is shown as 66 feet long—the dimension including the lead to the receiver. This type of aerial is known as an "Inverted L", it being the simplest of all such erections. The length 66 feet actually corresponds to a half-wavelength at 40 metres (7 Mc/s) and this is a compromise suitable for most purposes of general Short Wave reception. Those who are unable, because of lack of space, to erect such a length of wire should endeavour to get as much as possible in the circumstances. The aerial need not be in a straight line; it can be bent, but if this is done no angle should be sharper than 90 degrees; in fact, the greater the angle the better.

Another good general-purpose aerial is shown in Fig. 2B. Here the total length of the 'top' is some 49 feet 6 inches, this total length being broken at 33 feet from one end and a twisted pair of downlead wires inserted. Either end of the downlead could then be connected to the receiver input terminals, that connected to the longer portion being used for the lower frequencies and that connected to the lesser length for reception of the high frequencies, i.e., 15 metres and below. According to which of the downleads is being used, the remaining one should be taken to the chassis of the receiver or some other earthed point.

Probably the best wire to use for the aerial 'top' is 14 s.w.g. enamelled copper — the downlead of Fig. 2B being of ordinary twisted p.v.c. lighting flex of good quality.

Fig. 3 shows one of the best ways to obtain a good earthing system for the receiver. The earth wire can be of the same gauge and type as the aerial 'top' and should be firmly fixed to the copper rod—the latter being driven into the ground as far as possible. The purpose of the large flower pot, through the central hole of which is driven the rod, is that it will enable the surrounding earth to be kept damp, thus ensuring that a good earthed contact is made at all times. A jug of water tipped into the open end of the flower pot from time to time, especially during dry weather, will ensure that this is so.

**Broadcast Bands**

Short wave listeners as a whole may be divided into three main groups. There are those who are primarily interested in operating over the Broadcast Bands, those who prefer the Amateur Bands, and the remainder who are interested in both the Broadcast and the Amateur transmissions.

For the Broadcast Bands beginner it should be noted at the outset that these bands are to be found on comparatively small ranges of the receiver dial—larger 'empty' spaces being between them. These spaces are, of course, not really empty but contain a multitude of other services, such as press reports sent in Morse, 'scrambled speech'

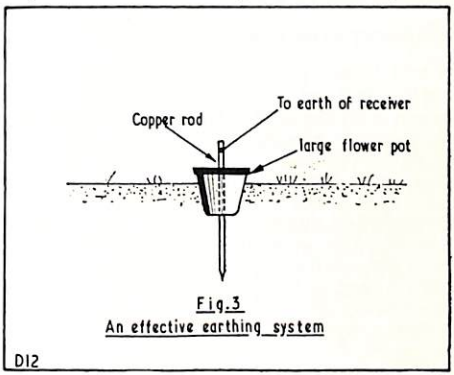



Fig.3
An effective earthing system

D12

messages unintelligible to the ordinary listener, ship-to-shore messages, navigational aids, air-to-ground reports and a host of other necessary services. The Broadcast Bands themselves are spread out as follows: the 11, 13, 16, 19, 25, 31, 41, 49 and 60 metre Bands. Each of these Bands contains a multitude of stations transmitting signals from every quarter and corner of the world.

To further explain the Broadcast Bands, let us take a closer look at just one of them in some detail. The 41 metre Band, for instance, lies between the frequency limits 7100 to 7300 kc/s (1 kc/s=1,000 cycles per second). In metres this equals the limits 42.25 to 41.10 metres. In actual fact, however, there are a number of stations both above and below these stated limits.

The beginner is accustomed to the wavelength of a particular station being stated in metres and, while this term is correct, i.e., wavelength in metres, it is more usual when dealing with short waves to state the frequency of the station in megacycles per

second. A kilocycle equals one thousand cycles (as stated above), and 1 megacycle= 1,000 kilocycles. This use of the megacycle is much more convenient when dealing with those stations operating on the higher frequency end of the spectrum, e.g., 21 Mc/s Band.

To find the wavelength of a station in metres, divide the frequency into 300,000, thus:—

$$\text{Wavelength in metres } (\textit{approx.}) = \frac{300{,}000}{\text{frequency (kc/s)}}$$

To find the frequency of a station in kilocycles, divide the wavelength into 300,000, thus:—

$$\text{Frequency in kc/s } (\textit{approx.}) = \frac{300{,}000}{\text{wavelength in metres}}$$

For example, a station transmitting on, say, a wavelength of 25 metres would have a frequency of 12,000 kc/s, thus:—

$$\text{Frequency in kc/s} = \frac{300{,}000}{25} = 12{,}000 \text{ kc/s or 12 Mc/s.}$$

In each band, stations are allocated channels at intervals of 5 kc/s apart, although not all stations transmit on multiples of this figure. The whole object of this 5 kc/s separation in frequency allocation is to prevent, as much as possible, interference between adjacent transmissions. This separation is not, in itself, sufficient to ensure absolute non-interference, but it does greatly assist in this respect.

currently operating in the 41 metre Broadcast Band. Looking at this carefully, a number of interesting points emerge—the beginner would do well to study such lists, particularly the band or bands in which he is especially interested, for much may be learnt in this way. The top seven stations in the table, all using the 7110 kc/s channel, are not only separated in respect to distance, but have broadcasting time schedules that only slightly overlap. It should be remembered that each have differing clock times and, in addition to this, often cater for listeners in differing sections of the world in which the local clock times are of some importance. Broadcasting a programme at the wrong time would merely mean that those at whom the programme is aimed would probably be in bed and fast asleep!

Radiated powers are also of great interest. The contraction 'kW.' is that used for the term 'kilowatt' (1,000 watts), the figure given being the power radiated by the transmitter referred to. Thus, that of Rawalpindi is given as 10 kW. This radiated power is, as can be seen from the list, used at all times, while that of the London transmitter is variable from 15 to 100 kW. Powers are varied according to the time, the conditions and the target area of the beamed transmission. Such transmissions are, more often than not, a regular feature of most broadcast stations. Programmes are directed to many parts of the world in a multitude of languages, this beaming being carried out by means of special aerial arrays which concentrate most

**Table 1**

| *Mc/s* | *Metres* | *kW.* | *Call* | *Station* | *Country* |
|---|---|---|---|---|---|
| 7.110 | 42.19 | 10/35 | | Colombo (V.O.A.) | Ceylon |
| 7.110 | 42.19 | 35/100 | | Tangier (V.OA) | Morocco |
| 7.110 | 42.19 | 15/100 | | BBC London | Gt. Britain |
| 7.110 | 42.19 | 5/8 | | Kampala | Uganda |
| 7.110 | 42.19 | 7.5/100 | | BBC Singapore | Malaya |
| 7.110 | 42.19 | 10 | | Rawalpindi | Pakistan |
| 7.110 | 42.19 | 20 | YDP3 | Medan | Indonesia |
| 7.115 | 42.16 | 120/240 | | Peking | China |
| 7.115 | 42.16 | 10/100 | | R. Free Europe | W. Germany |
| 7.115 | 42.16 | 10 | | Sebaa-Aioun | Morocco |
| 7.188 | 42.14 | 10 | YDU6 | Denpassar | Indonesia |
| 7.120 | 42.13 | 15/100 | | BBC London | Gt. Britain |
| 7.120 | 42.13 | 10/100 | VUD | Delhi | India |
| 7.125 | 42.11 | 6 | | Nairobi | Kenya |
| 7.125 | 42.11 | 18 | | R. Nationale | Guinea (Rep) |
| 7.125 | 42.11 | 7.5/100 | | Warsaw | Poland |
| 7.125 | 42.11 | 120/240 | | Peking | China |

In most cases, more than one station will be found to occupy a single frequency and, where possible, it will be noted from any Broadcast Station List that such stations are usually situated as far as possible from each other in the geographical sense. In Table 1 will be found a short list of such stations

of their radiated energy in one direction. Merely to receive a station broadcasting in Polish, assuming one understood the language, on or near the frequency 7.125 Mc/s, does not imply that the listener has heard Warsaw. He may have been listening to another station broadcasting their pro-

gramme in Polish and beamed to that country. Half the fun of Broadcast Band listening is in identifying the stations picked up—but more of this later.

Referring again to the list of Table 1, it will be noted that on 7.118Mc/s the station YDU6 Denpassar, is radiating at a frequency between the 5kc/s multiples of 7.115 and 7.120Mc/s, at a power of only 10kW. One would assume from this low power, and the frequency occupied, that this station would be rather difficult to receive. This would in fact be the case, unless conditions were exceptionai, as the transmissions from this station would, without doubt, be partially swamped to some degree or another by the much stronger stations on the adjacent frequencies. From the above remarks, it will be seen that a whole lot of information may be culled from a good Broadcast Station List. Without such a list, the average listener is completely lost. Two such lists that can be recommended are: *Guide to Broadcasting Stations*, published annually by Iliffe & Sons Ltd., and the *World Radio Handbook for Listeners*, published by O. Lund Johansen, also annually. Both of these may be obtained from The Modern Book Co., 19 Praed Street, London, W.2.

**Identifying Broadcast Stations**

The process of identifying Broadcast stations is not, apart from a few obvious exceptions, an easy one to master. As with most things, continual practice and experience provide the answer. The first step in identifying a particular station is to note the language and the approximate frequency of the transmission. Dealing with these two points first, it should not be thought by the beginner that one must be an accomplished linguist; every language has its own characteristics and sound and, after some little time spent on short waves, these soon become apparent to the average person. Regarding the frequency, and assuming that the constructor has calibrated his receiver at least every 100 kc/s throughout the particular broadcast band on which he is currently operating—see later under Receiver Calibration—he must, if necessary by interpolation, arrive at an approximate figure. Then, knowing the type of language, noting the time of day and the signal strength, each in itself providing a clue, the uncertainty as to which station is being heard is considerably lessened. In order to make absolutely sure, however, that one's detective work with the available clues has been correct, it is best to keep the station tuned in until an identification announcement is made.

Station identification is normally made by most short wave stations every quarter hour or, where this is not so, at least every half hour. In some cases, English announcements are added to those of the normal language used at that particular station; in others, where English is not used, mention of place names, e.g., the location of the station, is often made.

**Table 2**

**BROADCAST BANDS**

| *Metre Band* | *Frequency* |
|---|---|
| 11 | 25.060 to 26.100 kc/s |
| 13 | 21.450 to 21.750 kc/s |
| 16 | 17.700 to 17.900 kc/s |
| 19 | 15.100 to 15.450 kc/s |
| 25 | 11.700 to 11.975 kc/s |
| 31 | 9.500 to 9.775 kc/s |
| 41 | 7.100 to 7.300 kc/s |
| 49 | 5.950 to 6.200 kc/s |
| 60 | 4.750 to 5.060 kc/s |

Interval signals are another good pointer to station identification. In many cases, especially with the numerous South American stations (who, incidentally, are mostly to be found below 5,000 kc/s), such signals are composed of chimes, gongs and even trumpet fanfares! The writer has heard these Latin American stations using such interval signals as diving aeroplanes, cocks crowing and even sirens! Many stations often use commercial slogans which soon become recognisable—such as the often heard Coca-Cola announcement; others again radiate religious programmes; all of these are pointers to station identification as place names are often mentioned.

The *World Radio Handbook*, previously referred to, features not only most of the call-signs, which should always be listened for, but also the musical annotation of the interval signal. Identifying short wave stations can be quite good fun and, after a little experience and practice, the process is not so formidable as it first appears.

All in all, Broadcast Bands operation is most rewarding to those who develop a preference for it.

**The Amateur Bands**

Amateur Bands enthusiasts are, as the term implies, mainly interested in the reception of amateur transmissions. Such transmissions are radiated by thousands of enthusiasts from nearly every country in the world, the reception of some of these being a feat of considerable merit! The amateur listener operator, as a beginner, has much to learn and memorise if the full benefit of his chosen hobby is to be obtained.

The Amateur Bands themselves are listed

herewith. They are, in the main, used for specific purposes at varying times of the day. For instance, the 160 metre band, or 'Top Band' as it is often called, is used mainly for local contacts and 'rag-chews' (discussion sessions) late in the evenings and on Sunday mornings. The 80 metre band is similarly used, but for contacts further afield than provided by 'across town' Top Band. Near-Continental contacts are also made on this band. The next band—40 metres—is used during daylight hours for European contacts and at night, provided conditions are good, for Dx (i.e., long distance, or a rare or difficult-to-work-country). 20 metres is a good general all-round Dx band at most times of the day or night, while 15 and 10 metres are apt either to be 'wide-open' or conversely 'dead' according to the prevailing conditions and sun-spot cycle, etc. The above remarks are, of course, only general in nature —they should not be taken as a rigid ruling for, like most things in amateur radio reception and transmission, the unexpected often happens and there are all sorts of border-line events with respect to these

**Table 3**

**AMATEUR BANDS**

| *Mc/s* | *Known as* |
|---|---|
| 1.8 to 2 | 160 metres or 'Top Band' |
| 3.5 to 3.8 | 80 metre Band |
| 7.0 to 7.15 | 40 metre Band |
| 14.0 to 14.35 | 20 metre Band |
| 21.0 to 21.45 | 15 metre Band |
| 28.0 to 30.0 | 10 metre Band |

frequencies. It is possible to hear a G (British station) working a W (American station) on, say, the 80 metre band when conditions are good for such a signal path.

The Amateur world is divided into countries, each having its own prefix; for instance, that for Venezuala is YV. Countries are also grouped into 40 zones, our example, Venezuala, being included in Zone 9. Each station has not only a prefix (designating the country of origin) but also a figure; e.g., YV5, and this figure often identifies the district in which the station is located—in this example, it would be Caracas. The prefix and figure is further followed by two and sometimes three letters, thus YV5AB, each operator being allotted differing suffix letters. In this manner, any station heard may be located with respect to country, and often state or district, once the prefixes, etc., have been memorised.

Israel, together with many of the newly formed nations, has a prefix that is a mixture of figure, letter, figure—in that order; thus the prefix for Israel is 4X4, that for Ceylon 4S7 and that for Ghana is 9G1. However, all this presents no difficulty providing the beginner, or 'old-timer' for that matter, obtains a copy of *The Radio Amateur Operator's Handbook*, it being very difficult to memorise all the prefixes. This handbook contains all the information required when dealing with the amateur bands, and revised editions are issued annually by the publishers of this book. Codes, abbreviations, mileage, times, distances, charts, etc., are all featured. (*See page* 69.)

**CW or Phone?**

The amateur band listener sooner or later comes up against this eternal query. Briefly, those who can read *C.W.*, i.e., 'continuous wave', or Morse as it is better known to the beginner, will soon find their enjoyment of the bands very greatly increased. The beginner is usually tied to the phone portions of the bands—these being the higher frequency ends—by virtue of the fact that he cannot read the 'dots and dashes'. If he intends sending reports using QSL cards, he will soon find that many of the phone operating transmitters are often swamped with reports from listeners and, after a while, cease to reply to them. No member of the transmitting fraternity can be blamed for this—most listener reports being unsolicited and the cost of reply from the transmitter to the listener often being out of all proportion to the information imparted to him. Reporting on c.w. signals, however, is more useful, and likely to bring in replies since usually far less listeners read Morse than those who use phone only.

C.W. may be learnt either at the local club or by means of one of the various courses which are run by commercial concerns specialising in this type of instruction. It can also be learnt by self-instruction, listening to slow Morse practice transmissions put out by some members of the Radio Society of Great Britain. These transmissions are notified in that Society's monthly *Bulletin*. As experience is gained, some of the commercial or press c.w. stations can be copied as some of these send Morse at a reasonably slow speed. Practice at home with a Morse buzzer set can also be carried out and is of value in acquiring skill in sending. The best advice the author can give the beginner is to join the local club and the national Society just mentioned.

**Clubs and Societies**

For those beginners who are primarily interested in the amateur bands, the following notes may be of value.

The Radio Society of Great Britain (R.S.G.B.) is the official national society and once again we strongly recommend all amateur band listeners to join. The

address is: New Ruskin House, Little Russell Street, London, W.C.1. Local groups of the R.S.G.B. are scattered all over the country in most towns of any size and the address of the local secretary can be had from R.S.G.B. HQ. On joining the Society, each listener is allocated a British Receiving Station (B.R.S.) number. The monthly journal—*The R.S.G.B. Bulletin*—is free to members and contains constructional articles, society events and news, club notes, details of the Slow Morse transmissions already referred to, amateur band news and Dx notes, and so on. Much other literature is also available from the Society in the form of inexpensive books dealing with many aspects of Amateur Radio.

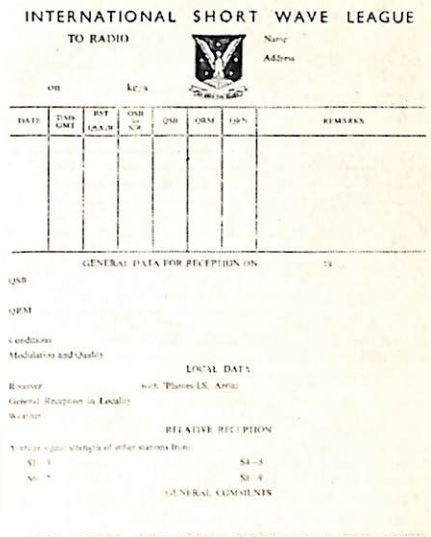
The International Short Wave League (I.S.W.L.) caters in the main for the listener but also includes many transmitters among the membership. The monthly journal *Monitor* contains news of both the amateur and broadcast bands, listener contests and League events, etc. A wide range of services is available to members. This society can be thoroughly recommended to the listener as he will find amongst its membership kindred souls to himself. Further particulars can be had from the League HQ.: 60 White Street, Derby.

Another publication of interest to the amateur bands listener is *The Short Wave Magazine*. Catering in the main for the amateur radio transmitter, much information of use to the listener is, however, to be found in this journal. Apart from constructional items, the Dx Commentaries dealing with the latest events on the amateur bands, conditions, etc., are of much help to the listener.

For those who are interested in sending reports to the Amateur transmitting stations, the A.R.R.L. *Amateur Radio Call Book* (American Radio Relay League) is an indispensable publication, listing as it does, the names, addresses and call signs of amateurs throughout the world. Another such publication is the R.S.G.B. *Amateur Radio Call Book*, a much more modestly priced publication than the former, but which contains only the names, etc., of British and Eire amateur radio stations.

## QSL'ing

The QSL card was, originally, a confirmation of a contact established between two transmitting amateurs, both of the participants


INTERNATIONAL SHORT WAVE LEAGUE

TO RADIO

Name

Address

on kc/s

| DATE | TIME GMT | RST QSA R | QSB QSA N | QSB | QRM | QRN | REMARKS |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

GENERAL DATA FOR RECEPTION ON

QSB

QRM

Conditions

Modulation and Quality

LOCAL DATA

Receiver with 'Phones I.S. Aerial

General Reception in Locality

Weather

RELATIVE RECEPTION

Another signal strength of other stations from:

S8 - S4

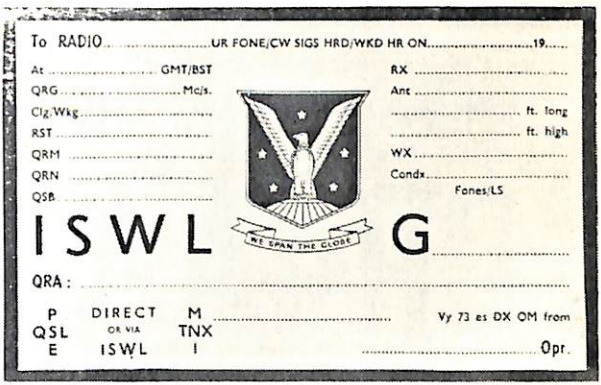
S6 - S3

GENERAL COMMENTS

PLEASE QSL DIRECT OR VIA I.S.W.L. 60 BARRINGTON ROAD, LONDON N.12

*The ISWL Report Pad*

exchanging their personal cards. With present day usage, however, most listeners and even most broadcasting stations have their own cards. In order to obtain a card from either an amateur or a broadcast station a report of that station's signals must be sent to the address from which the signals emanated. Before proceeding further in this matter, the beginner is strongly advised to obtain a supply of QSL cards and a Report Pad. Both of these are available from the I.S.W.L. QSL cards may, of course, also


To RADIO ..... UR FONE/CW SIGS HRD/WKD HR ON ..... 19.....

At ..... GMT/BST

QRG ..... Mc/s.

Clg/Wkg .....

RST .....

QRM .....

QRN .....

QSB .....

RX .....

Ant .....

..... ft. long

..... ft. high

WX .....

Condx .....

Fones/LS

I S W L

WE SPAN THE GLOBE

G .....

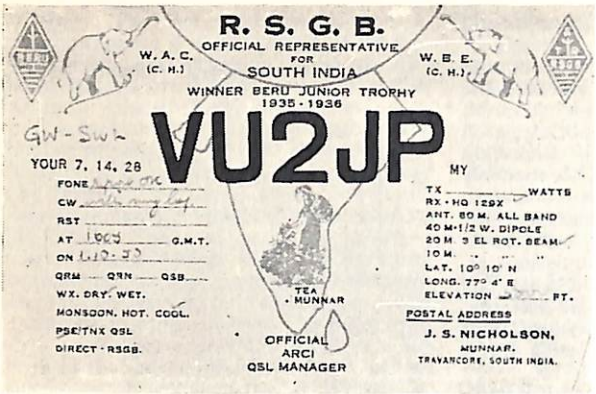
QRA : .....

P QSL E — DIRECT OR VIA ISWL — M TNX I

Vy 73 es DX OM from .....

Opr.

*QSL card as supplied to League members. Allocated League number may be overprinted.*




*Photograph of an actual QSL card from an Indian Amateur Radio Station. Such cards are, more often than not, colourful, interesting and original in design.*

be obtained from several printers who specialise in this particular field.

The subject of QSL'ing is, in itself, a large one which we can only briefly touch upon here. For those who are desirous of obtaining full information on the subject, the I.S.W.L. publish a booklet entitled *The Art of QSL'ing* and it is, to the knowledge of the writer, the only one that has appeared on this subject.

The beginner listener should realise, from the start, that a report to an amateur transmitter is unsolicited and, this being so, such a report must be helpful, informative and complete if a reply is to be received at all. The report should cover a period of time, say a week or even a month. Should the chosen period be that of a week, then the selected station should be tuned in each day at the same time. All possible information that could be of assistance to the station should be included on this report sheet. Such information should, ideally, include the weather prevailing at the time; cloud formation, temperature and barometric pressure. The times recorded should be G.M.T. Conditions on the band should be indicated, i.e., long or short skip; type of fading, e.g., long and slow, or fast 'flutter' fading, and the relative time between peaks and troughs of signal strength. The comparative signal strengths of other stations from the same locality should also be included if possible. Some comments on the programme radiated are also of great interest—they also prove that you really did hear the station! The call, interval signal and frequency of the station should, of course, also be entered on the sheet. Your own equipment, such as the aerial in use, its height, direction and type; the receiver details, etc., are also of interest to the transmitting station operator.

Having completed the report, the QSL card should then be completed to agree with the details of the last entry on the report sheet. These should then be placed into a

*Photograph of a QSL card from the Cape Verde Islands Broadcasting Station CR4AA.*

large envelope together with a self-addressed envelope and an International Reply Coupon, if the reply is to be made overseas from a country other than a Commonwealth member. From the Commonwealth, an Imperial Reply Coupon would be required. These coupons are obtainable at most Post Offices and effectively take care of the cost of reply, being exchanged for postage stamps in the country of the recipient. Such a coupon should not, however, be taken as a guarantee of reply—no such guarantee exists with respect to return QSL's. !

Some of the above remarks apply, of course, only to the broadcast enthusiast, especially where reference has been made to the period report. On the amateur bands, conditions are somewhat different in that the majority of amateurs have transmitters which are v.f.o. (variable frequency Oscillator) controlled. This means that they are able, at will, to rapidly vary the frequency of their transmissions. Under such conditions it is mostly impossible for a listener to build up a long period report. However, it is possible to make a report for the short period in which the transmitter is operating on or around one frequency. This should include all contacts established during the period by the station under observation. With amateur reporting, however, it is always wise for the listener to impart information of additional interest to the transmitter, such as the call-signs of stations that called but were not worked and any item of unusual occurrence, such as the transmitter breaking down, or a third station vainly calling in order to join in the contact, etc.

It is never wise for the listener to report on amateur signals originating within this country on say, the 80 metre or the 40 metre bands unless requested to do so. Usually, the transmitter is well aware of his radiation characteristics over the British Isles, the exception to this being when a new aerial or transmitting rig is tested. If you require a card from a British Isles amateur, then it is best to report on the 'top-band' transmissions of a station as far away as possible from your own location.

**Receiver Calibration**

The calibration of a home-built receiver is always something of a problem to the constructor. Usually the enthusiast is advised to 'calibrate the receiver against known station frequencies'. Now this is, in the writer's opinion, somewhat begging the question, it being of little assistance to the reader. In the first place, most broadcast stations announce simply that, 'This is so-and-so broadcasting in the 31 metre band'. if this 'so-and-so' happens to be either London, Moscow or some similar network, the beginner will find that there are several such stations listed as operating within that particular band. To make matters worse, these stations, together with many others, more often than not radiate on several channels in various bands at one and the same time. Thus we often get the announcement, 'This is so-and-so broadcasting in the 25, 31, 41 and 49 metre bands'. What is the beginner to make of all this? The practical answer when dealing with short waves is not to calibrate against stations at all. How then can the beginner, having completed his receiver, calibrate it with any degree of accuracy?

Before considering actual methods of doing this, the question of marking the dial must be investigated first. As an example, we will use a *Panel-Signs* dial. The reader will note that each semi-circular band is marked from 1 to 4. Band 1 of the receiver dial should therefore be marked and used for

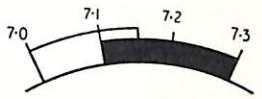



Fig.4
Method of marking bands on dial

DI3

the lowest frequency range, because at such frequencies 'spot-on' accuracy is not so important. On the other hand, for the higher frequencies, a longer total length of dial is required if all the 100 kc/s points are to be marked on it with any degree of accuracy. We see, therefore, that the lowest frequency ranges should be marked on Bands 1 and 2 and the higher ones on Bands 3 and 4.

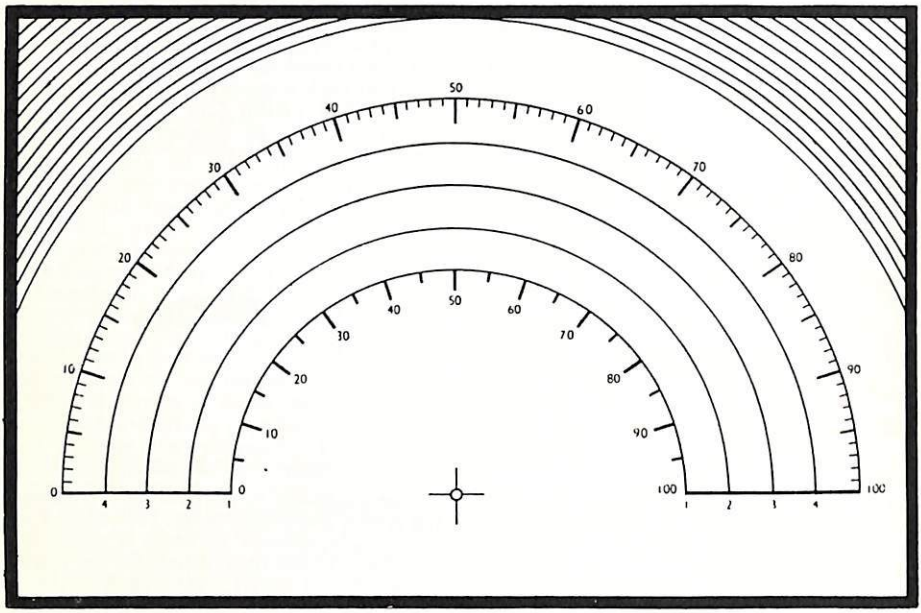
The actual marking may be done with indian ink or an ordinary Biro type pen. The latter method is somewhat easier, but if this is done, it is a wise measure to cover the completely marked out dial with a sheet of clear Perspex or similar material for protection. Using indian ink, it will be found that much finer lines and figures are possible. The various bands may be marked so that they form solid blocks, e.g., from say 7.100 to 7.300 kc/s, as shown in Fig 4.; with the 100 kc/s marks extended just above the mass of the completed band. Having dealt with the actual marking of the dial, we can return to the question of calibration.

Having fitted a Perspex pointer suitably marked with a 'hair line' and with the Band-spread dial pointer set at 1, the receiver should be set to a band edge—see later—the outer dial reading then being noted. This done, the pointer should be moved away and a mark made on the line being calibrated, at the appropriate point. This process is repeated for each band and, in this way, the whole dial may be calibrated with reasonable accuracy.

There are, of course, other and better methods of marking in the dial, but some of these are likely to be outside the scope of the average beginner. One such method is to fit a Perspex pointer having a fine slot made in place of the 'hair line'; a fine pointed pen then being inserted through this slot for direct marking. Yet another method is to fit a Perspex cursor so shaped that one side is both flat, and in line, with the centre of the condenser spindle, this edge being used both as the calibration marker and as a ruler against which the pen may be lightly rested.

For the beginner, the best practical advice that can be offered for calibrating his receiver is for him to enlist the aid of a local enthusiast equipped with a signal generator. Failing this, for the beginner left to his own resources, the best method is to deal with one coil at a time. The frequency limits of each coil are known from the manufacturers literature and, although this will vary somewhat with individual receivers and designs, such limits will not be unduly distorted. We know, therefore, the frequency range of the coil within small limits. Next consult that portion of the Broadcast Station List dealing with the bands and stations within these limits. Tuning the main dial around from 0 to 100 will soon reveal where the Broadcast Bands lie. Mark each end of such bands on the dial in pencil. The rough band edges are thus defined. Next, spend a session of some hours, if necessary, on one of these bands logging some of the more powerful stations and trying to identify them with the help of their announcements and the Broadcast Station List. After a while, it will be found that each band will fall into place, definite frequency check points appearing about which there is no doubt. Once this stage has been reached, it becomes possible to start inking in those marks about which no doubt exists and the calibration of the whole of the dial can eventually be completed. It should be emphasised that such a method of self-calibration is a long term project, although much may be learnt in so doing.

The medium and long wavebands may, of




*The Panel-Signs transfer dial referred to in the text.*

course, be calibrated against known station frequencies—this being a much easier proposition than that of calibrating a short wave band.

**Operating your Short Wave Receiver**

The efficient operation of a short wave receiver can only be accomplished after long practice and much experience on the various bands. Before commencing a listening period, several decisions must be made. First, on which band shall the session be made? Upon this decision will depend the coils required and the aerial to be used. It is better to decide on listening to some specified station than to wander aimlessly over the bands. After the initial novelty of tuning around the short waves has subsided, it will be found by most enthusiasts that such a policy proves the most satisfactory in the long run.

The next step is to switch on the receiver and allow it to warm up. The average short wave receiver working from a.c. mains requires some 15 to 30 minutes in which to attain its normal working temperature. During this warming-up period, it will be found that the tuned circuits will tend to 'drift' with respect to the tuned frequency. This slow 'drift', from one frequency to another, is caused by the heat radiated from the valves, gradually heating up the condensers, coils, etc., thus changing their characteristics. During this initial warming-up period, no serious listening should be attempted as continual retuning of the receiver is necessary. After this period has passed and the receiver has 'settled down', listening can commence in earnest.

The best method of operating a receiver such as the 'Meteor'—described in this publication—over one of the bands, is to set the bandset control on the higher frequency edge of the band, the bandspread control being set to 1 on the dial. Then, by using the bandspread control, the band will be found to 'spread out' over part of the range of this dial.

To obtain the best performance from a receiver such as the 'Meteor', the correct use of two further controls should be understood. The first of these is the reaction control, the correct use of which can make or mar the performance of such a receiver. This control should be adjusted in such a manner that the receiver is just below the point of oscillation, this being heard as a faint 'rustling' in the headphones, as if someone is making the sound 'sh'. The best way of ensuring that the reaction is, in fact, just below the point of oscillation is to advance the control so that continual oscillations take place. This condition is heard as a continuous rushing sound. Then slightly retard the control, until these oscillations cease. While tuning over the band, it will be found that adjustments have to be made to the reaction control from time to time. A little practice will soon enable the listener to do this almost unconsciously.

The remaining control requiring some understanding is the aerial trimmer. This variable condenser, inserted in series between the aerial and the receiver input, has the effect of electrically altering the length of the aerial and so its frequency response. Thus, each band will require a different setting of this condenser if the maximum signal transference from aerial to receiver is to be achieved. Such settings must be found by trial and error, but they soon become clearly evident. This control is also useful in eliminating reaction 'dead spots', i.e., frequencies at which no reaction is obtainable even though the reaction control is at maximum. This sometimes happens through the aerial damping the oscillator circuit.

For those who require to receive c.w. or Morse signals, the reaction control must be advanced until the set just oscillates. The incoming signals 'beat' with the internally generated oscillations, producing an audible 'beat note' of a few hundred cycles per second in the headphones.

Operating a short wave receiver is an extremely enjoyable and satisfying hobby; it requires some patience, particularly at the outset, and not a little skill, but the latter is soon acquired as experience is gained.

# SOLDERING

# NOTES . . . .

PROBABLY THE GREATEST CAUSE OF FAILURE in receivers constructed by the beginner is bad soldering. A badly soldered joint is, more often than not, a 'dry' joint, i.e., one that is not making a good electrical contact. Such a joint forms a high resistance and often an intermittent contact which can, and often does, lead to all kinds of trouble when later testing the receiver. Most dry joints are caused by incorrect soldering and/or the natural desire of the beginner to hurry and complete the receiver in order to hear it working.

For general radio work, an electric soldering iron of the pencil bit type is ideal. Small and efficient, especially where used with a cored-type solder—available from most radio retailers—it produces plenty of heat energy for the average radio joint, which usually consists of a wire end or two and a solder tag, or valve pin, etc.

Before use and when new, the working surface of the copper bit must be tinned. To do this, the iron should first of all be connected to the a.c. mains supply and allowed to reach its working temperature. As soon as this happens, and before the atmosphere has caused oxydisation to set in, cored solder should be applied over the whole face of the working surface. Any excess solder must now be removed with a piece of old rag. Once the iron has been tinned, it should not require any further attention for a considerable length of time.

The piece of rag, previously referred to is not often mentioned in radio literature but it should never be far from the work bench. If the iron subsequently becomes comes dirty, it should be wiped with the rag to remove all such dirt and excess solder.

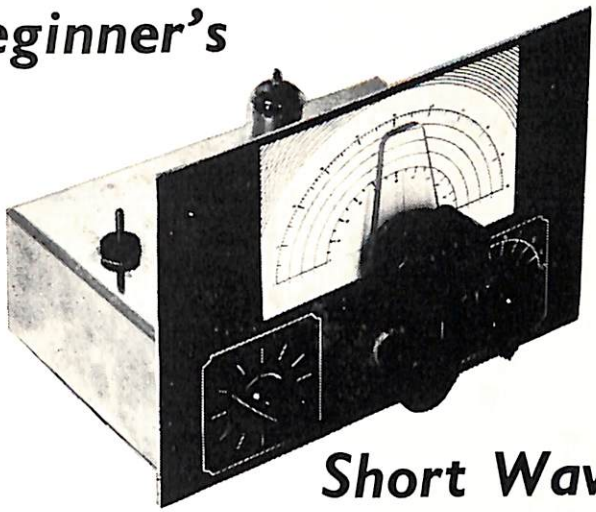
When making a radio joint, attention should be given to the mechanical aspect as well as to that of the soldered electrical joint. When soldering, for instance, to a valve holder tag, first ensure that the tag itself is clean and free from grease—the arch-enemy of a good soldered joint. Provided this is bright and clean, and likewise the wire end to be secured to the tag, the wire should be passed through the tag and bent back upon itself by means of a pair of pliers. Next, the actual soldering process. Hold the end of the solder on the required joint and apply the iron, removing the solder immediately sufficient of this has been melted. Continue to hold the iron on the joint until the solder runs freely all over the wires, etc. Remove the iron and allow the solder to cool without moving either the wire end or the tag. Should either of these be moved before the solder has cooled, then it is certain that a dry joint will result.

For success in soldering, then, the very first thing to ensure is that the parts to be joined should be clean and free from either dirt or grease. Where these are present, they may be removed either by the application of a little methylated spirits, applied with a piece of rag, or by filing with a small file, or scraping with a sharp instrument such as a penknife. A small piece of emery cloth is useful for this purpose. The second rule is to make a good mechanical join once the parts have been cleaned. This not only ensures that a good soldered joint will result, but will also impart mechanical rigidity to the suspended components, allowing a good anchorage and also ensuring that the parts do not move during the actual soldering process. The third rule is to apply the solder and then the iron, allowing the joint to attain the required temperature for the melting and the free running of the solder. Fourthly, once the solder has freely run all over the joint, never move any of the wires, etc., until the solder has cooled.

Provided all of the above simple rules have been observed, the beginner will find that all the soldered connections he has made will be sound ones and not the dreaded dry joint—the source of so much trouble—and so difficult to locate during the testing stage. After a little practice and experience, the beginner will soon find that he has mastered the technique of soldering.

**WORLD-WIDE RECEPTION with the**

# Beginner's



# Short Wave Receiver

This receiver differs somewhat from the other designs offered in that the coils, of which there are two, are switched or changed over by means of a front panel control. The simple coil and switch unit is fully described and illustrated, therefore the beginner need have no qualms about tackling this wavechange assembly. As in the other receivers described here, the actual wiring and assembly instructions are fully described, stage by stage, first as a one-valve and then as a two-valve receiver.

From the heading illustration it will be seen that the completed receiver, whether as a one- or two-valve assembly, has been designed with a symmetrical panel layout—eye appeal always being of some importance in that often, if one is pleased and proud of the visual appearance, then confidence is imparted with respect to the ultimate performance of the receiver. In any event—why construct a receiver containing a 'hodge-podge' of panel controls?

**Circuit**

This is shown in Fig. 1, and from this it will be seen that it is an 'economy' circuit in that only the barest essentials, consistent with reasonable results, have been incorporated into the design.

The inset to Fig. 1 contains details of the coil connections. The circuit is that of a simple leaky grid detector incorporating two coils (Osmor Type SWQ1 and SWQ2) which are switched from the front panel by means of the Yaxley type switch. The frequency coverage of these coils is from 31 to 11 Mc/s and 12 to 4.5 Mc/s with a nominal 150pF variable condenser. With the circuit as shown, with its additional bandspread condenser and stray capacities, the coverage is somewhat different—as may be expected. The coils have adjustable iron dust cores and this will not only affect the reaction obtainable at various positions of the variable condensers, but will also vary the coverage somewhat according to their position. The frequency range, as measured with the prototype receiver, was 21.0 to 9.6 Mc/s and 11.2 to 4.7 Mc/s approximately.

$C_1$ is the bandsetting condenser, while $C_2$ is the bandspread condenser. For best results these should be of the type specified, as they are of heavy silver-plated brass, rigid and dependable in operation. The grid condenser $C_4$ is of the ceramic type and this together with $R_1$, has a value chosen to provide a time constant which will, with the other circuit values, produce positive feed-

back or reaction free from overlap or backlash. This is important if maximum sensitivity is to be obtained from the receiver.

The valve chosen to operate as the detector is the well-known 1T4 miniature variable-mu r.f. pentode, this being available both on the new and the surplus market at the present time. For those who may already have some valves on hand of the 1.4V filament type, the

this being controlled by the variable condenser $C_3$, sometimes called the 'throttle' control. $R_2$ is the anode load, and $R_3$, together with $C_5$, ensures that the screen grid operates at maximum efficiency under the conditions imposed by the remainder of the circuit.

The phones are inserted into the h.t.+ line. Power supplies are obtained from an

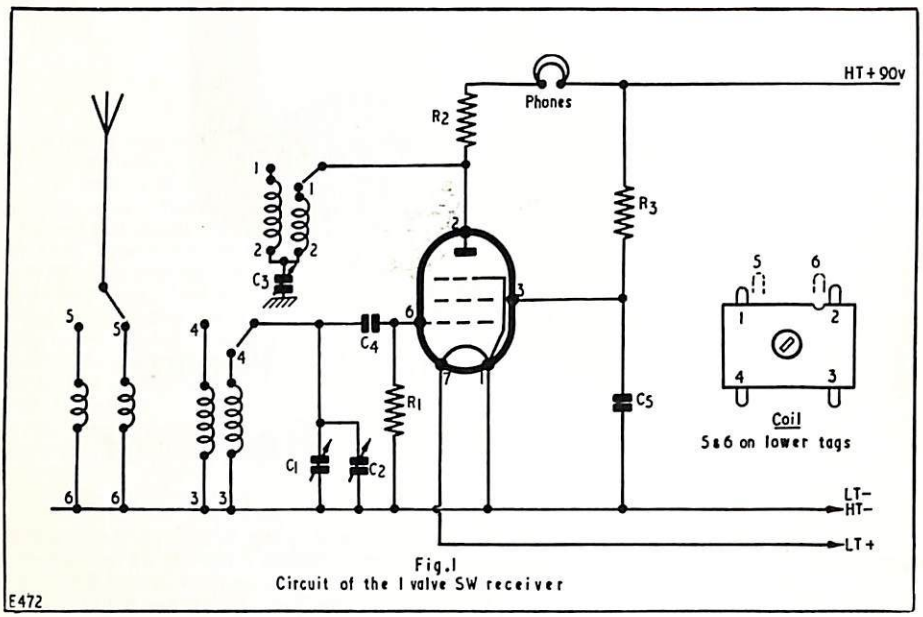



Fig.1
Circuit of the 1 valve SW receiver

## List of Components

$R_1$ 2M Ω ½ watt
$R_2$ 10k Ω ½ watt
$R_3$ 22k Ω ½ watt
$C_1$ 140pF variable, Eddystone type 586
$C_2$ 25pF variable (Home Radio) Ltd.
$C_3$ 100pF variable, Eddystone type 585
$C_4$ 100pF ceramic (Home Radio) Ltd.
$C_5$ 0.1μF, TCC type CP45N
Battery—Ever-Ready type B103
Headphones—2000 Ω
Coils—Osmor types SWQ1, SWQ2
Wavechange switch,—Yaxley type 3-pole, 2-way
Aerial/Earth socket, etc.
Chassis—6 in. × 4 in. × 2 in.
Panel—7 in. × 5 in.
Knobs
Valve—Brimar 1T4, with McMurdo holder
Grommets
Panel-Signs—Set No. 1

following types are direct equivalents, and the substitution of any one of these for the 1T4 specified will not require any alteration with regard to circuit values. The equivalents are: Mullard DF91, Osram W17, and Mazda 1F3. The numbers shown around the valve in Fig. 1 refer to the actual pin numbers of the valve base.

Reaction is obtained by positive feedback,

Ever-Ready type B103 90V h.t. plus 1.4V l.t. dry battery.

### Physical Layout

The physical layout of both the chassis and the panel may be seen, at a glance, from the photographs and from Fig. 2, the front panel, and Fig. 3, the chassis deck and backdrop.

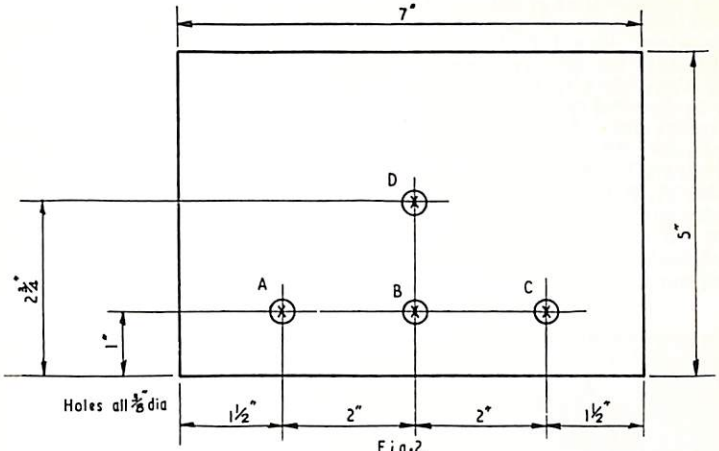
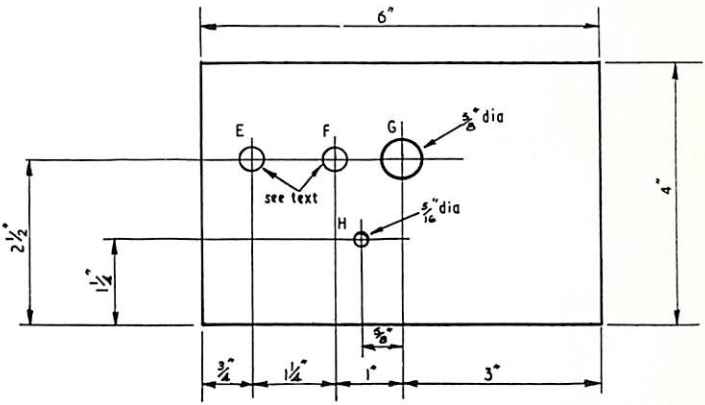



Fig.2
Front panel details



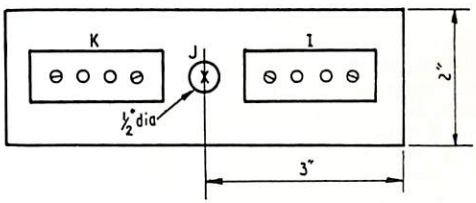



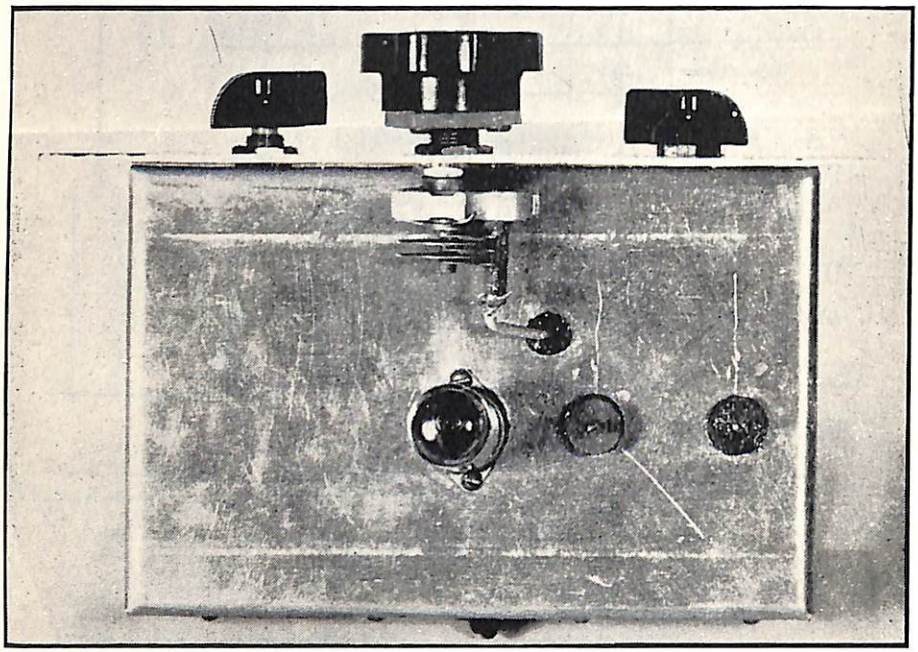

Fig.3
Chassis & backdrop

E473

The first item to be drilled is the panel, and the required measurements for this are shown in the drawing. Should the beginner not have the facilities for drilling holes of the required diameter, the largest sized drill to hand should be used and the hole enlarged with a small round file. An 'Abrafile' is ideal for this purpose. Once the front panel has been completed as shown in Fig. 2, the lower three holes (A, B and C) should then be used as a template for the front-drop of the chassis. In this manner both the panel and the chassis holes will coincide once these two are fixed together.

The chassis back drop contains the aerial and earth Paxolin strip (1), the large rubber grommet for the power input lines (J) and a further Paxolin strip for the headphones (K).

Having drilled both the chassis and front panel, we now proceed with the assembly work. Fix the panel and chassis together by securing into position the wavechange switch (hole A), the reaction condenser (hole B) and the tuning condenser (hole C). Next, secure into position the small bandspread condenser (hole D). A glance at the photographs and diagrams will clarify the foregoing. Having completed this, mount the valveholder and



*Above-chassis Component Layout*

Next, the chassis deck should be tackled. Measurements for this are given in Fig. 3. Note should be made here of the fact that, in the prototype, holes have been drilled through the chassis into which the coil bodies have been force fitted. Some constructors, however, may prefer to mount these two coils on a Paxolin strip and mount this strip to the chassis wall by means of stand-off insulators. If this latter method is adopted, then clearly a slightly different layout will be required. The holes E and F are those of the coils, G that for the valveholder, and H is that to which the small rubber grommet is fitted at a later stage.

the coils. Dealing with the valveholder first, ensure that this is mounted correctly positioned, with pin 1 furthest from the coil, and pin 5 nearest to the coil. The coils should now be force fitted into position. Note how these are oriented from the under chassis photograph. The last stage of assembly is the mounting of the Paxolin strips on the backdrop. Care should be taken when mounting these that none of the female sockets make any contact at all with the chassis itself; this is very important. Having placed these into position, note that in each case the screw nearest the centre of the chassis backdrop has an earth tag fitted to it.

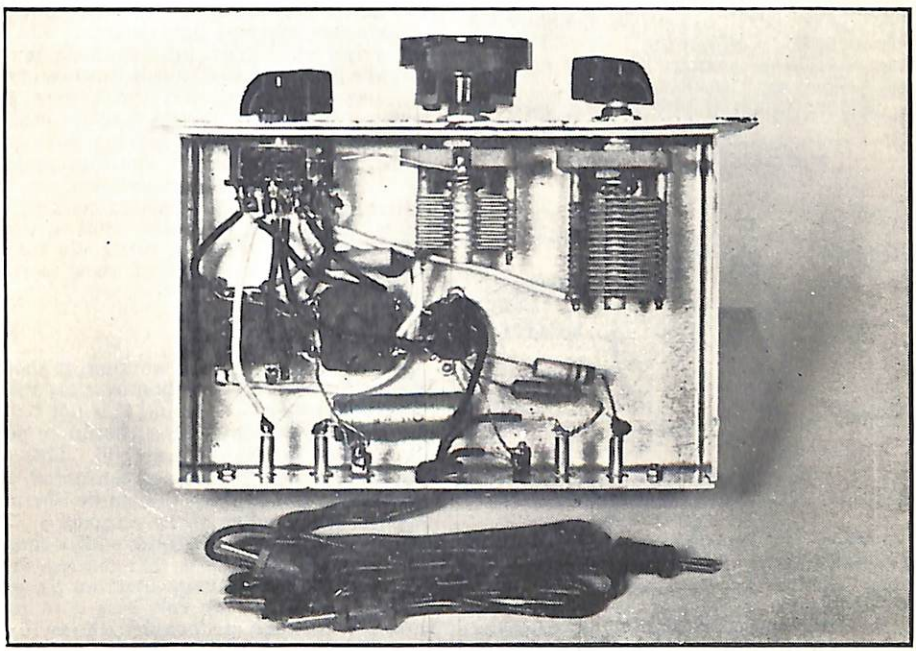
The rubber grommets should now be placed into position both on the chassis deck and backdrop. This completes the assembly work and the next stage is the wiring up of the circuit.

**Wiring the Circuit**

The best plan here is to commence with the power input leads, but before doing so, the beginner should have the circuit diagram before him so that as each wire, or component, is soldered into position, the appropriate portion of the diagram may be inked in or crossed out according to preference in method.

leads through the rubber grommet on the backdrop.

From the right-hand tag of the headphone strip (looking at the underside of the chassis) solder one end of $R_2$, $R_3$ being soldered to the left hand headphone tag, ensuring before so doing that both of the wires supporting these resistors are cut to the correct length and thoroughly tinned before soldering finally into position. The other end of $R_2$ should now be connected to pin 2 of the valveholder, and the other end of $R_3$ to pin 3 of the valveholder. To pin 3 of the valve



*Under-chassis component Layout*

The h.t.+ lead should be soldered on to that tag of the headphone Paxolin strip nearest the centre of the chassis; the lead should be about 12 inches in length (as with all the other leads connected to the battery). The l.t.+ lead should now be soldered to pin 7 of the valve base. The h.t.— and l.t.— leads should now be soldered to that earthed tag on the chassis backdrop nearest the headphone strip. Note here that only one lead is required for both the h.t.— and the l.t.— power connections. The other end of this particular lead should be connected to both the h.t.— and l.t.— connections on the battery at the appropriate time. Having completed the foregoing, feed all the power

holder also solder one wire of $C_5$, the other end of which should be soldered to that earthed tag mounted with the aerial and earth strip. Note that the condenser should be correctly wired into position, with that end having a coloured line around it being soldered to the chassis.

From the earthed tag to which the h.t.—/l.t.— lead has been soldered, connect a short length of bare wire to the central spigot of the valveholder, and from there to pin 1 of the holder. Pins 4 and 5 of the valveholder are left blank. To pin 6 solder one end of $R_1$, the other wire of which should now be connected to pin 1. To pin 6 also solder one end of $C_4$, the other end of which should be

soldered to the wavechange switch (see Fig. 4 for all wavechange switch connections).

From the earthed solder tag mounted with the aerial and earth strip, solder a length of bare wire to tag 3 of both coils (see Fig. 1). Next, connect a short length of wire from tag 3 of each coil and connect the other end to tag 6 of each coil. Solder tag 4 of each coil to the wavechange switch by means of a short length of wire. Connect tag 2 of each coil to one side of $C_3$ (the reaction condenser). Note that this connection should be made to the stator, or fixed, vanes. Connect the rotor, or moving, vanes of $C_3$ by means of a short length of bare wire, to the earthed metal portion of one of the wavechange switch supporting shoulders (see photograph). Connect tag 1 of each coil to the wavechange switch. Connect tag 5 of each coil to the wavechange switch.

Solder a length of wire from the anode of

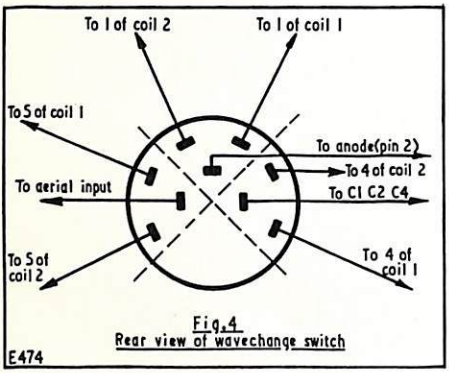


Fig. 4
Rear view of wavechange switch

the valve (pin 2) to the wavechange switch. Connect a length of wire from the aerial input strip (extreme left-hand tag) to the wavechange switch. Next, join the earth connection of the same strip to that earthed solder tag which has previously been fixed with it. From the wavechange switch, connect a length of wire to $C_1$ (mounted under the chassis), and from the wavechange switch also connect a length of wire to the band-spread condenser $C_2$, passing this wire through the chassis deck via the small rubber grommet.

The wavechange switch shown in Fig. 4 is a 3-pole, 2-way type, this being the recommended component. That shown in the prototype photographs differs somewhat from the type recommended, but this is only for the reason that it happened to be on hand at the time.

This has completed the actual wiring of the receiver; and the beginner is advised here to check over the foregoing, together with the circuit diagram, in order to obviate any errors which may have occurred during the wiring-up process. A few moments spent doing this may save trouble later when the testing of the receiver is carried out.

### Testing the Receiver

Having checked the wiring with the circuit, the next procedure is to test the receiver. Insert the valve and connect the aerial and earth, together with the headphones, into their appropriate sockets. Next, connect the l.t.— and l.t.+ plus into the correct battery terminals. Upon doing this, the valve filament should glow, but in order to see this, it may be necessary to 'cup' the valve with one's hand in order to exclude any external light source. Should the valve not 'light up,' then it would indicate that the l.t. wiring is 'open circuit,' i.e., incomplete, between the battery and valve; assuming, of course, that the valve is itself not unserviceable. Having proceeded so far, with the filament glowing, connect the h.t.+ lead to the connection on the battery. Adjusting the reaction control just below the oscillation point until a slight breathing sound is heard, rotate the tuning condenser until a signal of some sort is received.

### Operational Notes

With the receiver now working, it should be possible to obtain reaction over the whole range of both coils. Should this not be so, then the coil iron-dust cores should be positioned about midway in each coil. This will alter the frequency coverage somewhat, but it will allow smooth reaction to be obtained over the entire range of the receiver.

Another point to remember with a simple receiver of this nature is that the length of the aerial will have a large effect on the performance. The golden rule here is to erect an aerial as high as possible, away from surrounding earthed objects, such as trees or gutters, and as long as permissible in individual circumstances. The earth should ideally be to ground and not connected to an internal water pipe, etc.

In operation, the reaction condenser should be advanced or retarded in step with the main tuning condenser and so adjusted that it is always just below the point of oscillation. This requires some little practice at first, but the beginner will soon become used to this and become quite expert in a short time. For c.w. (morse) reception, of course, the reaction condenser must be advanced just into the oscillating position, when it will then be possible to hear morse signals.

Having tested the receiver and found it working satisfactorily, the next, and last, task will be that of making the panel look

something like the prototype shown herewith. First, the panel should be painted with black enamel obtainable from the local walk-round store. When this is thoroughly dry, cut out and apply the 'Panel-Signs' transfer to the panel. The method of doing this is fully described on each packet of transfers. In this case, the varnish will not be necessary, it only being required to fix the transfers with the gum contained on the rear of them.

# Adding an Audio Stage

**Adding an Audio Stage**

Full details are now given for an additional stage that may be added by the beginner as time and available cash permit. By adding a further audio stage, the l.f. gain is not only greatly increased, but the apparent range of the receiver becomes greater than hitherto.

The addition of this stage has been kept as simple as possible, so that the beginner can have ample confidence in taking a further step forward with regard to receiver construction.

**Circuit**

This is shown in Fig. 1, where it will be seen that the additional audio stage is constructed around the Mullard DL96, a B7G-based output pentode capable of delivering 0.2 watts into the headphones—more than adequate audio for the average person.

The output is taken from the detector stage (1T4) via $C_6$ into the grid of the DL96. Also to this grid are connected the grid leak $R_4$ and the automatic grid bias component $R_5$, the latter being decoupled by $C_7$. The

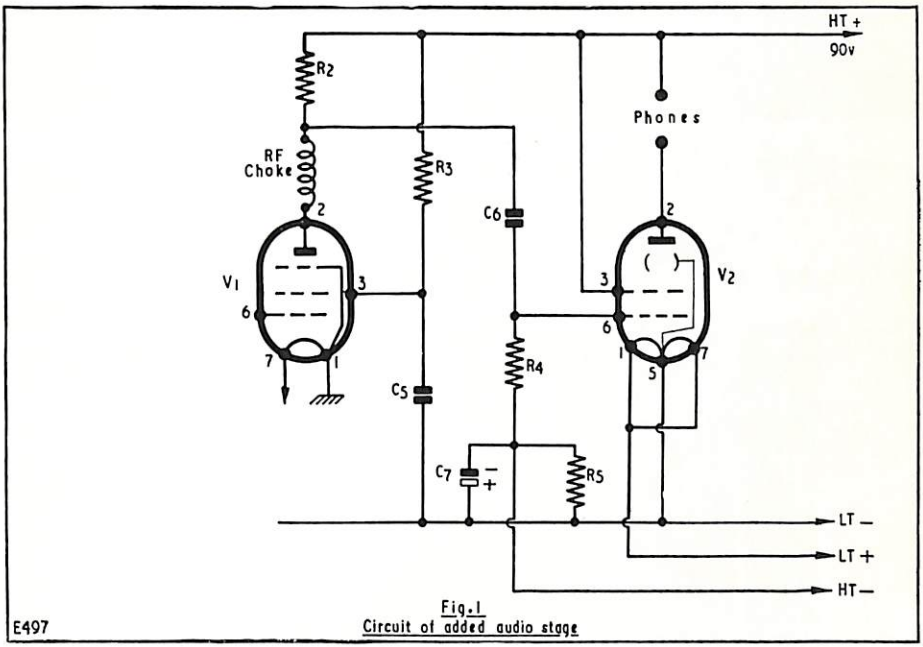


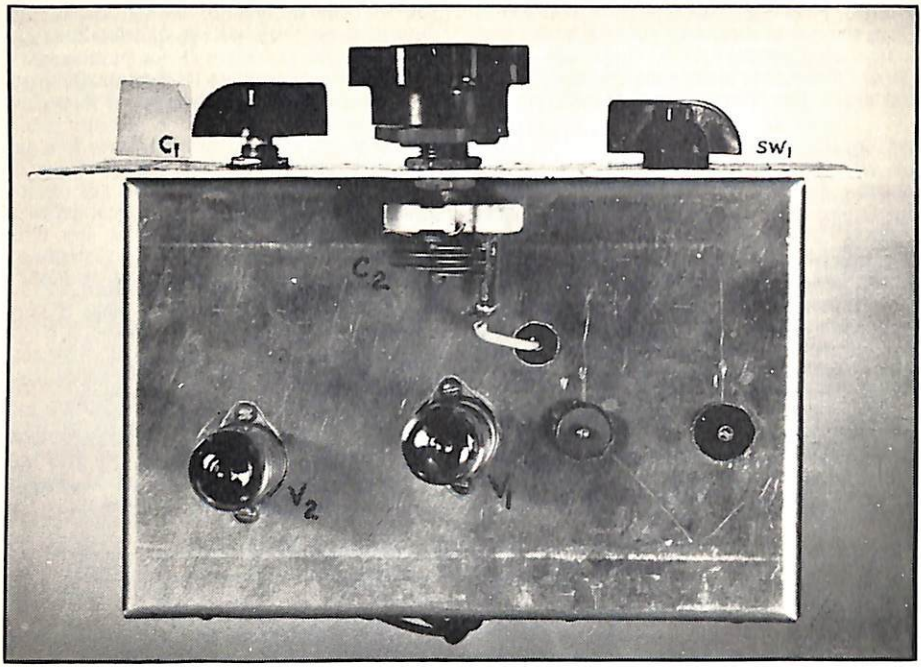

Fig. 1
Circuit of added audio stage

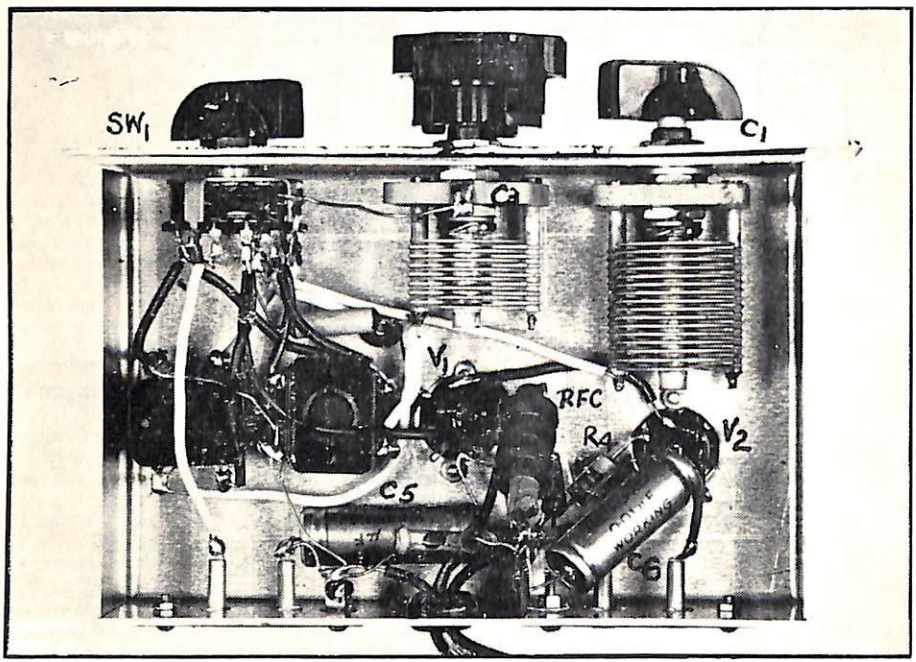
**Component List**

FOR THE ADDED AUDIO STAGE

| | |
|---|---|
| $R_4$ | 2.2M Ω ½ watt |
| $R_5$ | 470 Ω ½ watt |
| $C_6$ | 0.01μF, TCC type CP45W |
| $C_7$ | 25μF 12V wkg. electrolytic |

R.F. choke, Teletron SW R.F. choke
Valve, Mullard DL96 with holder
5-way tagstrip, centre-earthed.




*Above, and below, chassis views of the Beginner's Short Wave Receiver, two-valve version.*

inclusion of the resistor $R_5$ obviates the necessity of a grid bias battery with the consequent expense of continued renewal and additional external connections. The headphones are shown connected into the anode circuit, and the insertion of these completes the anode h.t. supply of the output stage. The suppressor grid of the output stage is internally connected to the earthed filament line. The screen grid is connected direct to the h.t.+ line. The only additional components for the constructor to purchase apart, of course, from the valve and valveholder, are the short wave r.f. choke, $R_4$, $R_5$, $C_6$ and $C_7$. Thus it will be seen that the extra components necessary for the addition of this stage have been kept to an absolute minimum consistent with reasonable results.

A further reference to Fig. 1 will show that part of the detector stage has been repeated, insofar as it affects the additional stage. Little else need be said about the output stage and we now proceed by describing, step by step, the necessary alterations and additions required to complete the two-valve receiver.

**Preliminaries**

Disconnect and remove from the anode of the detector (pin 2) the resistor $R_2$ (10kΩ), and having done so place this on one side, as it will be required later. Disconnect that end of $R_3$ (22kΩ) soldered to one side of the headphone output sockets and the h.t.+ input line. Unsolder the earthed connection of the h.t.— lead (previously connected to the earthed solder tag on the chassis backdrop) and remove this from the receiver altogether. Having done this, unsolder from the same earthing tag that wire connected to the central metal spigot of the detector valveholder. Remove from the chassis backdrop the now free earthed tag by unbolting from the chassis. Having completed the above, switch off the iron and proceed to fit the new valveholder on the chassis deck. The position of this is shown quite clearly in the photograph reproduced herewith, and no measurements are deemed necessary as the location is self-explanatory. Having drilled or cut out the chassis, but before drilling the two holes necessary for fitting the holding screws, care should be taken of the orientation of the valveholder itself. It should be noted that pin 7 is nearest the Bandsetting condenser and pins 3 and 4 nearest the chassis backdrop. Having made sure that this is so, fix the valveholder into position and fit under that nut nearest the chassis backdrop the earthing tag previously removed from the backdrop.

In that aperture on the backdrop previously containing the now refitted earthed tag, a screw is fitted to hold into position a five-way tagstrip (see photo of the underside of the chassis). This five-way tagstrip is that type having four 'free' tags—two on either side of an earthed holding tag.

Having completed all of the above instructions, we now proceed to solder and wire into position the new components required to complete the output stage.

**Wiring the Output Stage**

It is best to commence this by wiring into circuit the l.t. supply of the added valve. With a short length of suitably covered wire join pin 7 of $V_1$ to pins 1 and 7 of $V_2$, and follow this by connecting a short length of bare wire from the metal spigot of $V_2$ to both pin 5 of the same valve and the earthed tag fitted under the valveholder.

From the right-hand tag of the phones output socket, looking at the underside of chassis, connect a length of wire to pin 2 of the output stage. From the right-hand tag of the same strip, solder a length of wire to pin 3 of $V_2$.

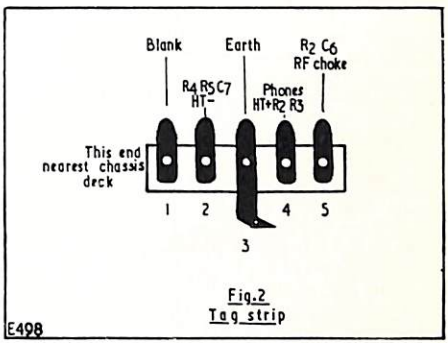



Fig.2
Tag strip

Dealing next with the added 5-way tagstrip, solder to that "free" tag (i.e. not earthed), next but one to the chassis deck (see Fig. 2), a new length of wire sufficient to reach the battery. Feed one end of this through the rubber grommet, and at the far end of this wire affix a battery plug. This wire will, in future, be the h.t.— supply line. Insert through the rubber grommet the old combined h.t.— and l.t.— supply line and solder one end of this to the earthed solder tag contained on the chassis backdrop. This will now become the l.t.— lead only.

From that tag of the tag-strip containing the newly added h.t.— line (2), join one end of $R_4$, $R_5$, and the negative side of $C_7$. Connect the other end of $R_5$ to the earthed tag on the chassis backdrop and the free end of $R_4$ to pin 6 of $V_2$. Connect the positive end of $C_7$ to the earthed tag on the Ae and E socket strip.

Solder to the earthed tag (3) of the tag-strip the length of bare wire which was previously removed from the central metal spigot of $V_1$.

To the next 'free' tag (4) of the tag-strip (see Fig. 2), solder the now free end of $R_3$. To the same tag (4) connect one end of $R_2$ (10kΩ), the other end of this now being soldered to the next tag (5). Returning to tag 4, solder a short length of wire from this to the nearest socket of the headphone output strip. Also to tag 4 connect one end of the previously discarded h.t.+ line, having first fed this through the rubber grommet.

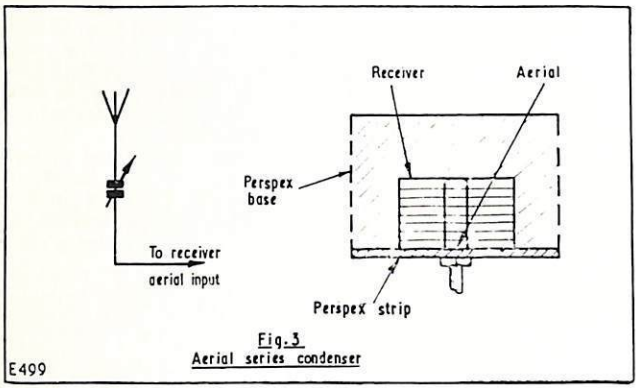


Fig. 3
Aerial series condenser

To tag 5 (see Fig. 6) solder both one end of the r.f. choke and $C_6$. Connect the other end of the r.f. choke to pin 2 of $V_1$. Solder the other end of $C_6$ to pin 6 of $V_2$.

This completes the wiring instructions for the new stage, and the chassis should now appear as shown in the photographs. Note that $C_7$ is not visible, being located underneath $C_5$. Note also that the connecting wires of both the r.f. choke and $C_6$ should be suitably covered with short lengths of systoflex in order to prevent short circuits occurring.

Having completed the above, it now remains to insert the two valves and to connect the battery, headphones, aerial and earth to the receiver.

## Dead Spots

Depending somewhat on the length of the aerial used with this or any 'straight' receiver, it may be found that over certain frequency ranges of the receiver 'dead spots' may occur, i.e., no reaction is obtainable. By far the easiest method of curing this source of trouble is to insert into the aerial lead, near to the receiver input, a small 100pF variable condenser. This condenser should *not* be earthed in any way, but merely be inserted in series with the aerial input (see Fig. 1). To achieve this satisfactorily, mount the condenser on a small panel of Perspex or Polystyrene. Connect the rotor (moving) vanes to the aerial lead-in and the stator (static) vanes to the receiver input.

It will be found that where dead spots occur, variation of this condenser will effectively eliminate them. It will also be found by experience that various settings of this condenser will increase the signal strengths of stations at certain frequencies. This is by virtue of the fact that the condenser electrically shortens the aerial, and thereby causes the latter to resonate at, or near, that frequency in use by the station being received.

# SIMPLE

# ALL-WAVE

# RECEIVER

## Part I

THIS RECEIVER WAS ORIGINALLY DESIGNED as a standby set for those occasions when the main equipment was being used on a differing frequency—as is sometimes the case when an amateur contact is taking place with one transmitter radiating on 80 metres and the other on, say, the 160 metre band. It is an ideal receiver for the beginner to construct in that, with the first version, the valves used are of the octal type. This valve has a somewhat larger base than the other types featured in this book and, since this is so, it follows that the actual valveholder is also of larger physical dimensions. The use of such a larger type of valve and valveholder enables the beginner—probably wielding a soldering iron for the first time—some degree of latitude with respect to the iron bit and the surrounding components.

Octal valves themselves are easily obtainable and are, in fact, current equipment types—not being obsolete by any means. They are obtainable either brand new or as 'surplus' types.

A comparable design, but using the miniature types, is described later and, in this manner, the intending constructor has the choice of two receivers each incorporating a differing type of valve but both using the same range of plug-in type coils. These are the Denco (Clacton) Ltd. miniature dual purpose coil of the Green range (see Component Lists). The coverage of these coils is as follows:— Range 1, 750 to 2000 metres; Range 2, 195 to 580 metres; Range 3, 57 to 180 metres; Range 4, 20 to 60 metres; and Range 5, 9.5 to 28 metres. The actual coverage of the receiver will, of course, be somewhat different by virtue of the fact that a bandspread condenser has been included in the design. The range to be expected is as given for the 'Centurion' receiver. (*See page 50*).

### Circuit Description

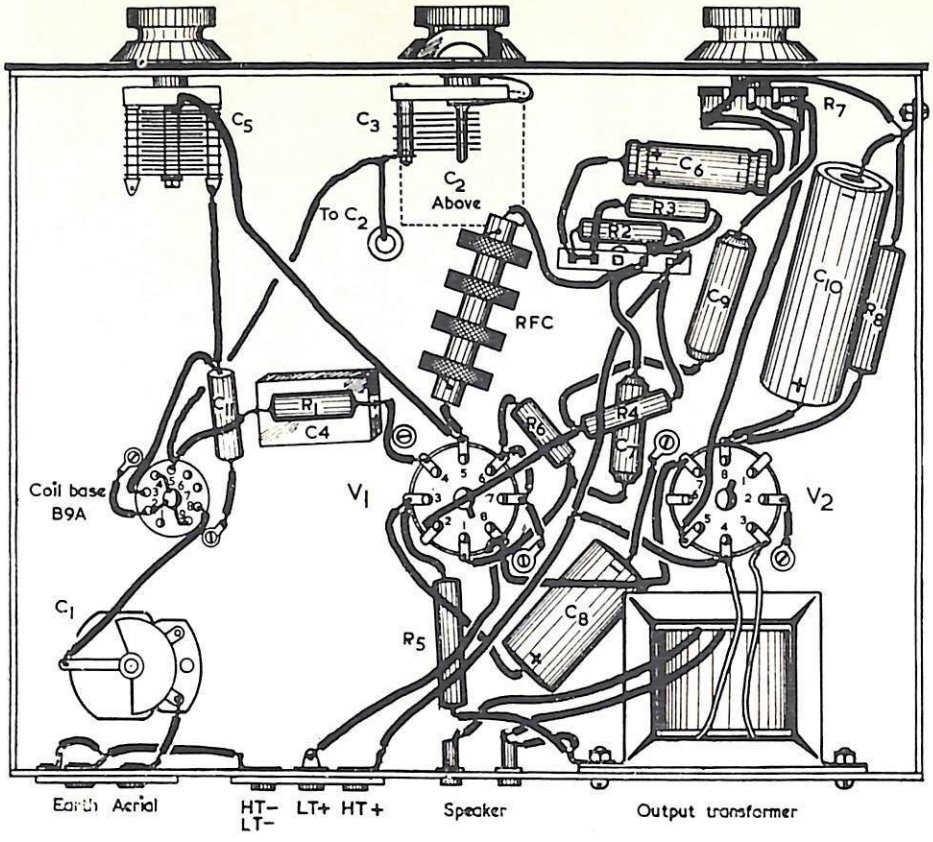
With this receiver, the minimum of components has been used consistent with reasonable efficiency. The power supply has been constructed as a separate unit, partly for the reason that it is required for other apparatus at times, and partly for the fact that most beginners prefer to build a power supply as an individual item of equipment.

In the first stage of the receiver, a 6SL7GT high-mu double triode acts as detector and first audio amplifier, the resultant audio being fed directly into the output stage via a volume control. The output stage is entirely conventional and consists of the 6V6GT output beam tetrode.

Plug-in coils are used as these have several advantages for the beginner over the manufactured coil assembly types. They are available separately, and may be thus purchased one at a time if required; also the use of these coils obviates the need for a switching system with its attendant losses and, to the beginner, its complex wiring.

A series aerial condenser is incorporated in order to avoid 'dead spots' with the reaction control. In the prototype shown herewith, this is mounted on the chassis, but if preferred, this could easily be mounted on the front panel thus allowing instant variation without recourse to screwdriver adjustments for each coil inserted.

The output transformer is of the midget variety enabling this to be mounted under the chassis and on the chassis backdrop.




Components shown out of scale for clarity

Cont

**Circuit**

This is shown in Fig. 1, the aerial being fed into the primary winding of the coil via $C_1$, the variable condensers $C_2$ and $C_3$ being the bandset and bandspread controls respectively. $R_1$ and $C_4$ form the grid components of the leaky grid detector. Reaction is obtained by varying the condenser $C_5$. As this is in series with the anode it therefore has an r.f. potential across it. This being so, the actual condenser must *NOT* be earthed to the chassis at any point.

The resistors $R_2$ and $R_3$ form the decoupling and anode load components which, together with the associated bypass condensers $C_6$ and $C_{11}$, ensure that smooth reaction is obtained, in association with the other detector circuit components, over the range of the receiver.

The audio output of the detector stage is fed, via $C_7$, into the grid of the following triode portion of the 6SL7GT, where $R_6$ acts as the grid leak component. Cathode bias is supplied via the resistor $R_5$ and the

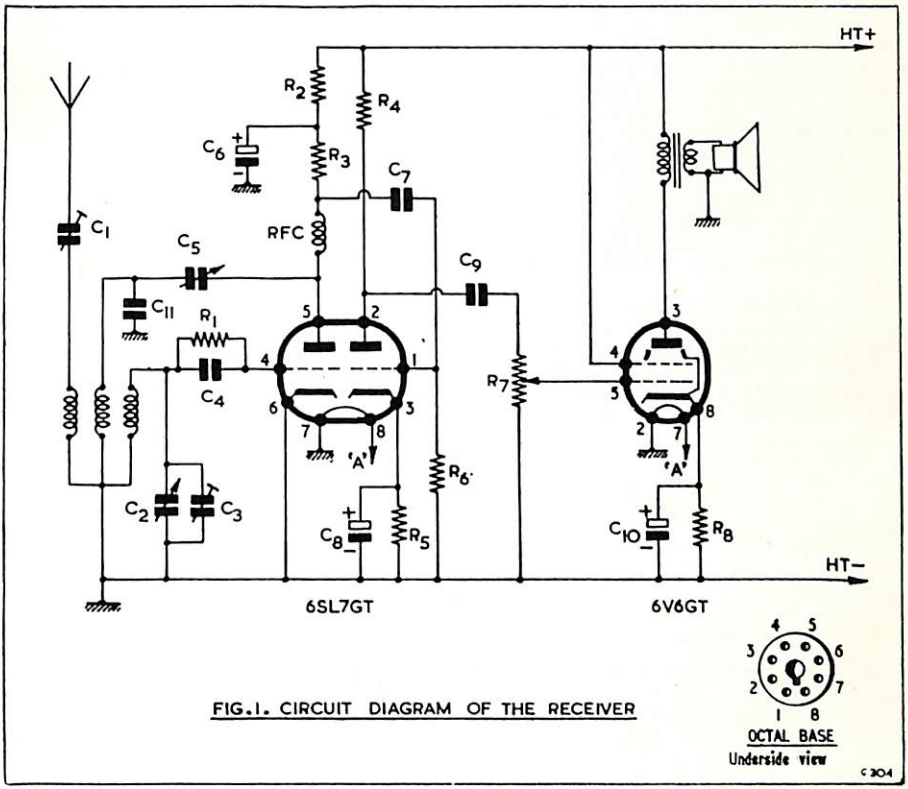



FIG.1. CIRCUIT DIAGRAM OF THE RECEIVER

As mounted in the prototype, two insulating washers and a short length of paxolin tube have been used in securing the component to the front panel—effectively isolating the metal parts from the chassis and panel. The same object may be achieved by cutting out a small square from the panel and bolting into position a slightly larger square of paxolin, through which a hole has been drilled enabling the condenser to be mounted. If adopting this method, however, ensure that the condenser fixing nut does not itself come into contact with the panel or chassis.

electrolytic condenser $C_8$. $R_4$ is the anode load and the output of this first audio amplifying stage is taken, via $C_9$, into the volume control $R_7$.

The output stage is entirely conventional and one with which the beginner soon becomes conversant, the 6V6GT being a very popular output valve with home constructors. $R_8$ and $C_{10}$ are the bias components.

**Constructional Notes**

Providing the circuit as shown in Fig. 1 and the illustrations are studied carefully

from time to time as construction advances, no difficulty should be experienced by the beginner. The layout is straightforward and, commencing with the detector portion of the double triode valve, the logical sequence of wiring follows thus: 1st audio stage followed by the output stage.

All the resistors are ½ watt and the ratings and types of the various condensers are given in the component list. All of the specified parts are currently obtainable on the market—suppliers of the various items used being stated where applicable.

Drilling details of the front panel, chassis and chassis backdrop are given later. Beginners are advised to obtain the components and also a chassis size 7 in. by 5 in. by 2 in. together with an aluminium panel size 7 in. by 6 in. A slightly larger panel and chassis will, of course, do no harm; one does not necessarily have to conform strictly to either the sizes stated or the drilling details given. Provided the panel and chassis are of sufficient size, the remaining point of importance is to ensure that the layout of the components as shown herewith, are followed reasonably closely.

Fig. 1, in addition to showing the circuit of the receiver, also features a small inset. This is the octal valve base as seen from the underside, and this, in turn, refers to the numbers shown on the circuit around each valve. Thus, in the detector stage pin 6 is the cathode and must therefore be wired to an earth tag.

When mounting the actual valveholders, one earth tag should be bolted to each holder, using one of the self-same bolts which secure the valveholder to the chassis. In this way, each valve has its own earth return.

The speaker is separate from the receiver, a small 5 in. type being sufficient for the purpose, it being fed from a paxolin strip mounted on the receiver chassis backdrop.

**Power Supply**

This is shown in Fig. 2. It is generally conceded that the power pack is the item of equipment which frightens the beginner most of all. Having perhaps had some experience of battery supplies with 90 or 120 volts of h.t., the —to the beginner—'high voltages' of mains equipment, in this case 200 volts or so on load, is apt to be somewhat of a problem. This being so, it is proposed to clearly itemise the construction of the power pack.

The chassis size is the same as that for the receiver—5 in. by 7in. by 2 in.—Provided the same mains transformer and rectifier as specified are used, the following instructions, if carefully carried out, will result in a power supply which will cause no worry at all.

Before commencing, however, a few words about power supplies and the very

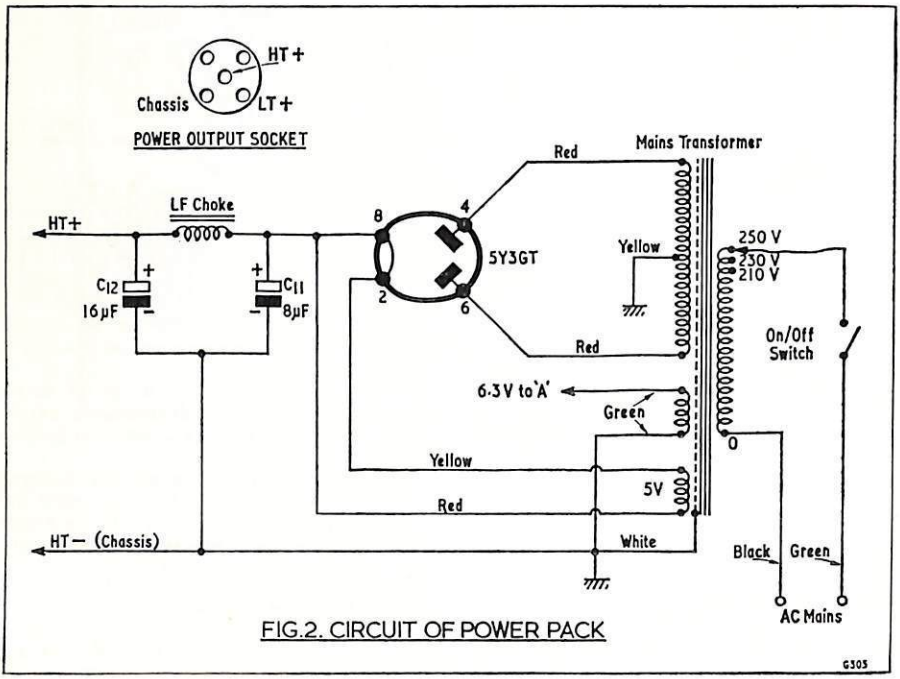
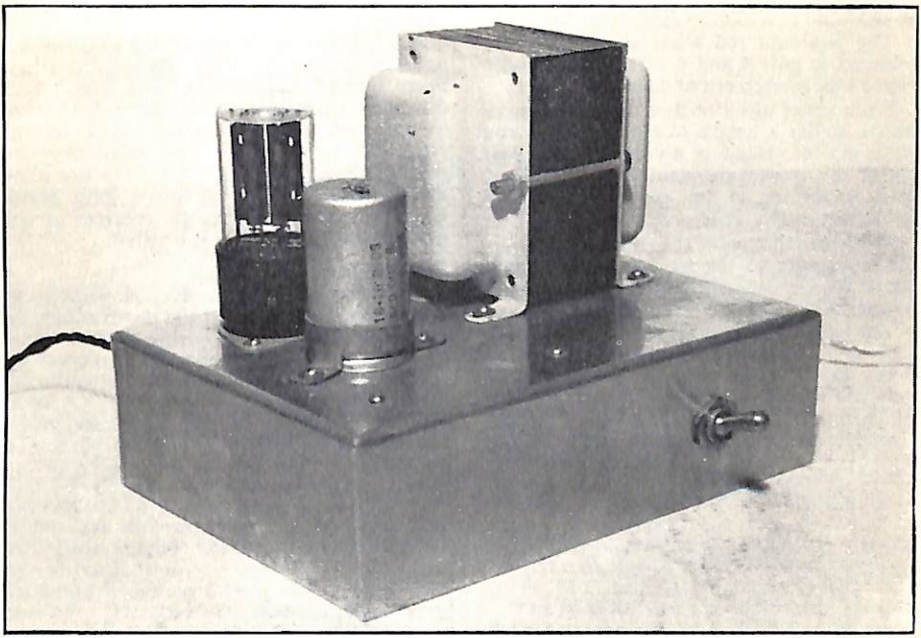



FIG.2. CIRCUIT OF POWER PACK



*The power pack of Fig. 2 when completed. General view of the above chassis components.*

obvious precautions to be taken AT ALL TIMES will not come amiss. With the unit completed, and connected to the receiver, NEVER make any adjustment or alterations to the circuit with the power supply either switched on or connected to the mains. If you insist on making any alteration while the set is working, then place one hand behind your back—or better still—put one hand in your pocket.

With the components mounted on the chassis as shown in the photograph, not forgetting the use of rubber grommets for ALL leads going through the chassis back, commence wiring as follows.

*Mains transformer.*—White, yellow and one green lead (one of the thick enamel covered ones) should be connected to chassis. This connection is soldered to the earthed tag of the tag strip mounted on the chassis wall. The other thick green lead is connected to pin 3 of the valveholder, and from there a short length of wire is taken to the appropriate tag of the power output socket (see Fig. 2). NOTE: In case you are mystified by the use of pin 3 of the valveholder, this is used solely as a holding tag—no connection is made to the actual valve, by virtue of the fact that the 5Y3GT has no pin 3 at all. The thin red and blue wires should have their open ends taped with insulation tape and then be tucked away under the paxolin strip. Ensure that the taping is done efficiently, that neither open end is in contact with each other and that no accidental connection is made with the chassis.

The thin black wire should next be soldered to a free tag, i.e., not an earthed one, of the tag strip. The thin green wire should be similarly treated.

A length of twisted mains lead should now be fed through a rubber grommet affixed to the wall at the rear of the chassis. Baring both wire ends, solder one each to either side of the on/off switch. At a point near the tag strip, cut one wire only. Bare both ends of these cut lengths and solder one to the same tag already holding the thin black wire. Solder the other end of the cut length to the tag to which the thin green wire has previously been soldered.

On the other side of the mains transformers there are three red wires. Select the thick red wire and connect to pin 8 of the valveholder. (This wire is enamel covered). The thick yellow wire (also enamel covered) should now be connected to pin 2 of the valveholder. Before attempting to solder, however, ensure that the enamel is removed, otherwise a bad connection will result. One way of removing this enamel

is to scrape away the covering with either an old knife or a single-edged razor blade.

The two thin red wires should now be soldered to pins 4 and 6 of the valveholder —one wire to each pin of course.

From either pin 2 or 8, it does not matter which, solder a length of covered wire, the other end of which is secured to the 8μF tag of the smoothing condenser, and from there to the tag of the smoothing choke—it does not matter which tag.

From the other tag of the smoothing choke, solder a length of covered wire to the 16μF tag of the condenser and from there to the power output socket (see Fig. 2).

The power supply is taken from the power pack to the receiver via a short length of 3-way cable. This cable is terminated at each end with a miniature plug arrangement which inserts into an appropriate socket forming part of a paxolin assembly mounted on both the receiver and power pack chassis backdrop.

Having completed the wiring as described, next check that the above instructions have been carried out, check with the circuit diagram, then insert the valve. Connect to the mains supply socket via a suitable plug and switch on. The valve filaments should glow red, switch off. Do not allow the power pack to run for a long period when not connected to the receiver as this will eventually damage the valve.

**Conclusion**

With the information given, together with the circuit diagrams and the illustrations, the beginner, and those requiring a small stand-by receiver, may go ahead and construct the power pack while at the same time gathering the components for the receiver. A comparable design using the miniature valves 12AT7, 6BW6 and EZ41 follows.

## List of Components

*Resistors*

$R_1$ 1M Ω ½ watt
$R_2$ 10k Ω ½ watt
$R_3$ 100k Ω ½ watt
$R_4$ 100k Ω ½ watt
$R_5$ 1k Ω ½ watt
$R_6$ 470k Ω ½ watt
$R_7$ 500k Ω Pot
$R_8$ 270 Ω ½ watt

*Valves*

6SL7GT Brimar
6V6GT Brimar

*Chassis and Panel*

*Output Transformer*

Miniature type

*Coils*

Denco (Clacton) Ltd. Miniature dual purpose (Green) Ranges 1 to 5

*Condensers*

$C_1$* 25pF variable
$C_2$ 365pF JB single-gang type 'D'
$C_3$* 25pF variable
$C_4$ 100pF, mica
$C_5$* 75pF, variable
$C_6$ 2μF, 350V wkg, TCC type CE17N
$C_7$ 0.02μF, 350V wkg, TCC type CP33N
$C_8$ 25μF, 25V wkg, electrolytic
$C_9$ 0.02μF, 350V wkg, TCC type CP33N
$C_{10}$ 25μF, 25V wkg, electrolytic
$C_{11}$ 100pF, ceramic

* Available from R.C.S. Products (Radio) Ltd.

*R.F. Choke*

The Teletron Co.

*Valveholders*

McMurdo

*Paxolin Strips, etc.*

## Power Pack Component List

*Chassis*

*Mains Transformer*

Ellison type MT161

*Tag Strips, Plugs and Sockets, etc.*

*L.F. Choke*

10H, 60mA

*$C_{11}$ and $C_{12}$*

8×16μF, 350V wkg, electrolytic

*Valve*

5Y3GT Brimar

# SIMPLE ALL-WAVE RECEIVER

## Part 2

ALTHOUGH THE RECEIVER PREVIOUSLY described was recommended as a design for the beginner, there is no reason why that offered herewith should not also be constructed by the learner. The main constructional difference lies in the fact that with these smaller based valves, there is far less physical room around the actual valveholder in which to mount the various components. The use of a miniature soldering iron is advised in order to avoid heat damage to the surrounding components.

The circuit about to be described is very similar to that featured in the last chapter, except that the 6SL7 detector stage has been superseded by a 12AT7, and the 6V6GT output stage by a 6BW6—the octal variety, therefore, being replaced in the design by the B9A (Noval) types.

As before, the power supply is separate from the receiver, the 5Y3GT being replaced by the Mullard EZ41 miniature B8A rectifier.

The receiver front panel layout is exactly the same—the chassis, of course, being somewhat different to accommodate the smaller type valves.

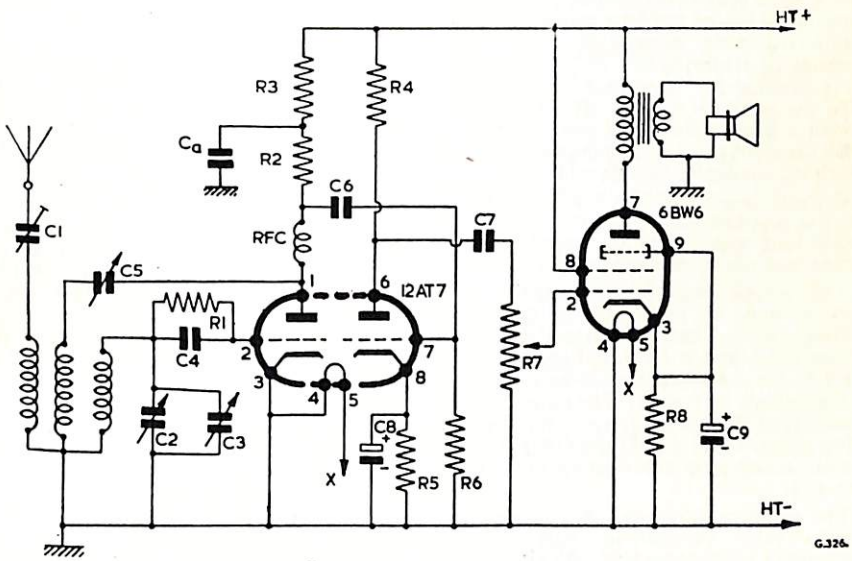



Fig. 1. Circuit of receiver.

## Circuit

This is shown in Fig. 1, where it will be seen that a 12AT7, a high slope double triode is used. The first half is functioning as a leaky grid detector, with the output of this being fed into the second half which is operating as the first audio stage. From here the resultant audio signal is taken into the output stage, a 6BW6 beam tetrode.

The aerial is taken to the primary coil winding via a chassis mounted 25pF variable condenser, this being of the type that is isolated from the chassis itself, and fixed into position by means of two bolts being screwed into two metal shoulders supported at one end by the ceramic body of the component. The variable condensers $C_2$ and $C_3$ act as the bandset and bandspread controls respectively, while $C_5$ is the reaction control (see following paragraph). $R_2$ and $R_3$ are the detector anode resistors which, with the R.F.C. complete the anode h.t. circuit. The output from the detector portion of the 12AT7 is fed via $C_6$ into the following triode grid.

Before continuing further, mention must be made here of the reaction control $C_5$. As this is connected direct from the anode, it carries r.f. potential and must, therefore, not be in contact with the chassis at any time. The method of mounting used in the prototype was to insulate the condenser bush and fixing nuts by means of two paxolin washers and a short length of paxolin tubing—the latter being placed over the condenser bush before mounting on the panel. Other methods of achieving the same object are: (*a*) mounting the condenser further back from the panel on a stand-off insulator, or (*b*) cut a larger hole in the panel and fix a small square of paxolin, through the centre of which the condenser may be mounted.

Cathode bias for the second half of the valve is supplied via $R_5$ and $C_8$. $R_4$ is the anode load with $C_7$ as the coupling condenser into the volume control $R_7$.

The output stage is conventional, but mention must be made here of the beam forming plates. These are connected to pin 9 of the valve, and it follows, therefore, that tag 9 of the valveholder must be connected to the cathode externally. The output transformer is of the miniature type, the speaker being plugged into the receiver output via a paxolin socket strip mounted on the chassis backdrop.

The numbers shown in Fig. 1 around the various valve connections refer to the appropriate valveholder tags. An alternative valve to the 12AT7 detector is the 12AU7 which may be inserted directly into the valveholder without any alterations to the wiring or components. Using this latter valve type, a low-mu double triode, will result in considerably less gain than that provided by the former type.

## Constructional details

Figs. 2 and 3 respectively give the dimensions and details of the front panel, chassis and backdrop.

The front panel should be drilled in the first instance, this then being used as a template for the chassis front drop. The chassis deck, followed by the chassis backdrop, are next drilled in that order. The main components should then be mounted; when wiring of the circuit may proceed.

The bandspread condenser was originally of the same value as that of the reaction control, the rotor and static vanes being removed and then replaced double-spaced, two rotor and three static vanes remaining as the modified condenser.

The chassis backdrop (Fig. 3) contains the separate paxolin socket strips for the speaker output, the power input and the aerial/earth connections. Also to the backdrop must be fixed the output transformer.

Each valveholder should be mounted together with its own earthed tag to which, dealing with $V_1$ first, should be wired tag numbers 3 and 4 together with the central metal spigot. With $V_2$, tag number 4 and the central spigot should be so treated. The metal casing of the volume control should also be wired to earth.

Once the receiver has been completed, the front panel, which as supplied is plain aluminium, should be painted, allowed to dry and the dial, etc., fixed. The full vision dial is that supplied with Panel-Signs Set No. 2, of which there are two such dials in every packet. Fixing instructions for this and the bandspread dial are contained on the rear of the envelope. In this instance, as there is little generated heat, there is no need to use varnish in order to mount the transfers on the panel, the gum being sufficient for the purpose.

The cursor was made out of a small piece of clear plastic sheet; this being cut and filed into shape, and mounted on the knob by means of three small Parker-Kalon self-threading screws. A scriber was used to mark the 'hair line' down the centre of the cursor —this afterwards being filled in with Indian ink. It is recommended that the type of knobs shown for the reaction and volume controls should be obtained. These knobs have a large skirt and, apart from looking attractive, in the case of the reaction control this reduces the possibility of hand capacity effects when adjusting the reaction control.

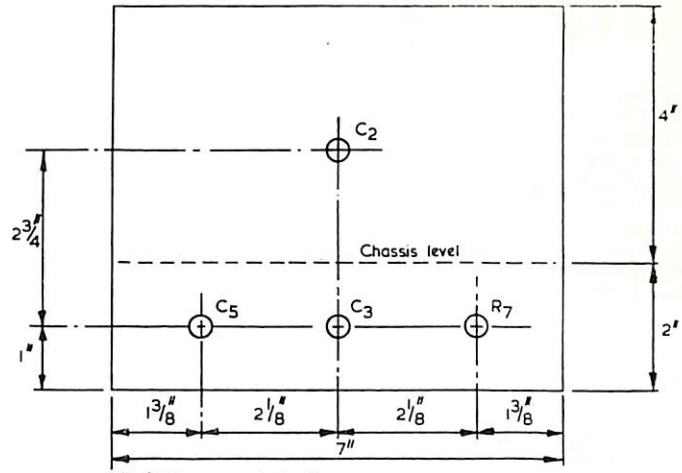
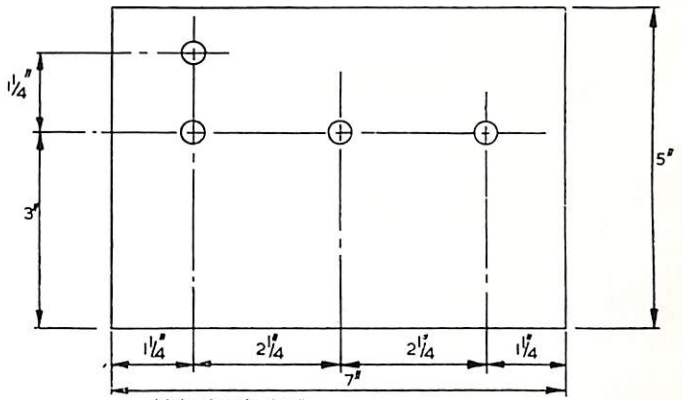
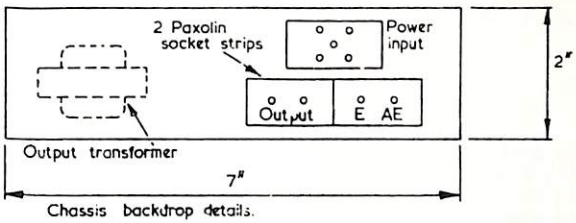



Fig. 2. Front panel details.




Main chassis details.




Chassis backdrop details.

Fig. 3

*Drilling details for both receivers.*

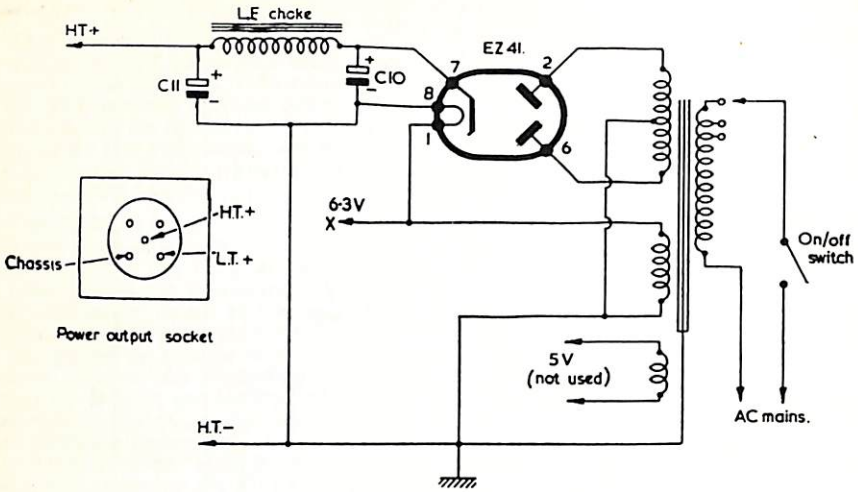



Fig 4. Circuit of power supply.

## List of Components

*Valves*
12AT7 Brimar
6BW6 Brimar
EZ41 Mullard

*Chassis*

*Mains Transformer*
Ellison type MT161

*L.F. Choke*
10H, 60mA

*Output Transformer*
Miniature type

*R.F. Choke*
Teletron Co.

*Resistors*
$R_1$ 1M Ω ½ watt
$R_2$ 100k Ω ½ watt
$R_3$ 33k Ω ½ watt
$R_4$ 33k Ω ½ watt
$R_5$ 1k Ω ½ watt
$R_6$ 470k Ω ½ watt
$R_7$ 500k Ω pot
$R_8$ 270 Ω ½ watt

*Valveholders*
McMurdo

*Knobs*

*Paxolin Strips, etc.*
H. L. Smith & Co. Ltd.

*Capacitors*
$C_1$ 25pF variable (see text)
$C_2$ 365pF J.B. single-gang type 'O'
$C_3$ 25pF variable (see text)
$C_4$ 100pF mica
$C_5$ 75pF variable
$C_6$ 0.02μF TCC type CP33N
$C_7$ 0.01μF TCC type CP45W
$C_8$ 25μF, 25V wkg, electrolytic
$C_9$ 25μF, 25V wkg, electrolytic
$C_{10}$ 8μF, 350V wkg, electrolytic
$C_{11}$ 16μF, 350V wkg, electrolytic
$C_a$ 0.01μF TCC type CP45W

*Coils*
Denco (Clacton) Ltd. Nos. 1 to 5, (Green Range)

**Power Supply**

The circuit for this is shown in Fig. 4. The chassis has exactly the same dimensions as that of the receiver chassis. It is not important how the main components are mounted and if the smoothing choke will not fit under an old existing chassis, where one is to be employed, it could just as well be mounted above the chassis deck; it should be at right angles to the mains transformer, of course. An on/off switch has been mounted on one of the chassis sides.

The chassis backdrop is used for the mains input, via a rubber grommet, and the power output to the receiver—for the latter a multi-pin plug and socket is employed. (See inset to Fig. 4). A similar arrangement for the power supplies exists on the actual receiver backdrop. Alternatively, two old valve bases and holders would suffice.

The power supply unit will supply adequate smoothed h.t. to the receiver.

**Alternatives**

A possible alternative to the physical layout shown herewith, apart from constructing both the receiver and the power unit on the one chassis—a larger one, of course—would be to obtain a larger front panel sufficient in size to accommodate both the receiver and power unit chassis placed end to end. This would be an ideal arrangement for the beginner, for, at a later stage in the hobby, the power unit could be easily detached for use with other equipment.

---

# Resistor Colour Code

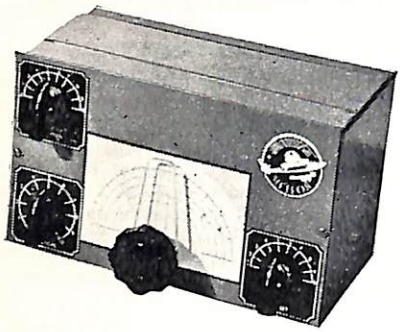
Resistors are valued in ohms ( Ω), and to denote this value each is painted in colours which conform to a standard code. There are three arrangements, the first of which employs a body colour, a coloured end, and a coloured spot superimposed on the body colour. In the second method this spot is replaced by a coloured band. Where either the spot or end colour, or both is not apparent, then the appropriate colour is the same as that of the body. In the third method of marking, four bands of colours are used, grouped towards one end of the resistor. The innermost band of these, and any silver or gold band which may appear in the other two methods, are used to indicate the tolerance percentage and for the purposes of this article may be ignored.

The body colour, or outermost band, indicates the first significant figure of the value. The end colour, or second band, gives the second significant figure. The colour of the dot, or band superimposed on the body, or that of the third band in the other method, gives the number of "noughts" to follow these two significant figures.

| *Colour* | *Figure* | *Colour* | *Figure* |
|---|---|---|---|
| Black | 0 | Green | 5 |
| Brown | 1 | Blue | 6 |
| Red | 2 | Violet | 7 |
| Orange | 3 | Grey | 8 |
| Yellow | 4 | White | 9 |

**Examples**

First, in some parts lists it will be noticed that some values are given in Ω (ohms), whilst others are in k Ω and M Ω. k and M are, respectively, abbreviations commonly used to denote thousands (kilo) and millions (Mega). Thus, 33 k Ω is 33,000 ohms, and 2 M Ω is 2,000,000 ohms—which is more often called 2 Megohms.



# THE "METEOR" MINI-RECEIVER

Before designing this receiver, the writer had to consider which type of circuit was the most suitable for a beginner to construct. Apart from the obvious choice of a "straight" circuit to ensure simplicity, consideration had to be given to the availability of components easily obtainable from most radio shops or mail order suppliers. Modern miniature components have been used, and in order to keep the cost at a reasonable level, as few components as possible consistent with efficient performance have been included in the design.

Coils of the plug-in type have been specified, a total range of from 10 to 2000 metres being possible with the set of coils specified.

**The Circuit**

The detector stage is built around the Mullard EF41 r.f. pentode, one of the B8A range. In the circuit diagram (Fig. 1), all the valve base connections are shown. For example, valve pin number eight is connected to chassis, which is, in effect, the earth. Further details of these connections are given later so that no possible mistakes with regard to valveholder wiring are made.

The aerial is connected to the coil primary winding via $C_a$, the inclusion of this ensuring smooth reaction without dead spots over the entire receiver range. The feedback winding is connected to the detector anode via $C_2$, a 70pF silver mica condenser. The tuned winding is that connected to the grid via $C_3$, a 100pF ceramic condenser. $C_1$ is the bandset condenser while $C_b$ is that used for bandspread. The h.t.+supply to the anode is via $R_2$, a 22kΩ resistor, and the r.f. choke. The screen supply via $R_3$, a 200Ω resistor, $R_4$, a 50kΩ potentiometer, and $R_5$, a 200Ω resistor and is bypassed to earth via $C_6$, a 0.1μF condenser. The variable potentiometer $R_4$ acts as reaction control by varying the applied voltage to the screening grid of the valve. This method of obtaining reaction is preferred in that no alteration to the receiver tuning is made by varying the voltage. Positive feedback (reaction) is obtained by the inclusion of both $C_2$ and $C_1$ in the anode feed to the reaction winding. The grid condenser and grid leak, $C_3$ and $R_1$, are of carefully chosen values in order to obtain efficient operation over the entire range of the receiver. The output of the detector stage is taken via $C_5$ into the grid of $V_2$.

For those who are rather apprehensive about trying out the receiver only when both valves are included, it is perfectly possible to complete only the detector stage as a first step, and, having connected the power supply, insert the phones between $C_5$ and chassis in order to obtain a signal. The phone socket, of course, will have to be wired into circuit before this can be done. This is shown in dotted line in Fig. 1, for those who wish to adopt this method and would rather advance stage by stage. The connection to the grid of $V_2$ and $R_6$ need not, of course, have to be broken if this is done.

The output stage is constructed around the Mullard EL42 Output Pentode. The circuit is perfectly straightforward and its purpose is to amplify the audio voltages arriving at the grid (pin 6), so that a much greater output is available for the headphones connected into the anode circuit. Once again the values have been carefully chosen and all are standard values easily obtainable. The resistor $R_6$ is the grid leak, or load across which the input voltage is built up,

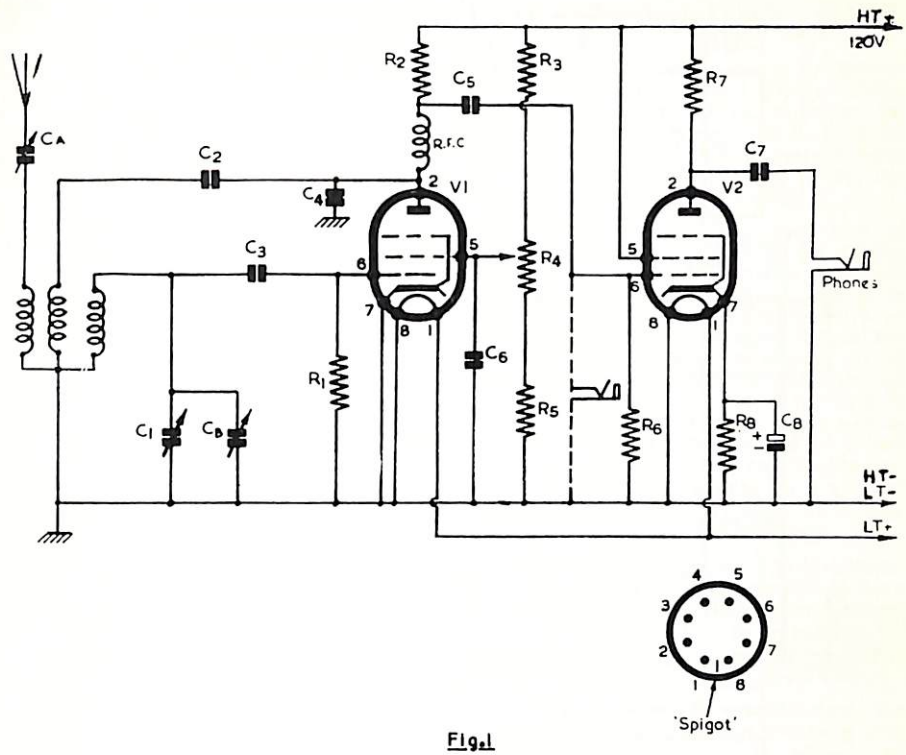



Fig.1

Circuit of the "Meteor" mini-receiver

E208

## List of Components

*Resistors*

| | | |
|---|---|---|
| $R_1$ | 2M Ω | ½ watt |
| $R_2$ | 22k Ω | ,, |
| $R_3$ | 200 Ω | ,, |
| $R_4$ | 50k Ω | Potentiometer |
| $R_5$ | 200 Ω | ½ watt |
| $R_6$ | 470k Ω | ,, |
| $R_7$ | 200 Ω | ,, |
| $R_8$ | 150 Ω | ,, |

*Valves*

| | |
|---|---|
| $V_1$ | Mullard EF41 |
| $V_2$ | Mullard EL42 |

*Panel, Chassis and Cabinet*
R.C.S. Products (Radio) Ltd.

*Headphones*—High Impedance type

*R.F. Choke*—Teletron Co.

*Power Unit type PU1*
R.C.S. Products (Radio) Ltd.

*Phone Jack and Plug*

*Condensers*

| | |
|---|---|
| $C_a$ | 100pF, variable, Eddystone type 585 |
| $C_b$ | 25pF, variable, J.B. type C804 |
| $C_1$ | 365pF, variable, J.B. type D |
| $C_2$ | 70pF, Silver Mica |
| $C_3$ | 100pF, Ceramic |
| $C_4$ | 100pF, Ceramic |
| $C_5$ | 0.01μF TCC type CP45W |
| $C_6$ | 0.1μF TCC type CP45N |
| $C_7$ | 0.1μF TCC type CP45N |
| $C_8$ | 25μF 25V Electrolytic, Dubilier |

*Coils*
Denco Miniature Dual Purpose, Green, Ranges 1 to 5.

*Valveholders*
2 of B8A, 1 of B9A

*Additional Parts*
PVC wire, Nuts, Screws, Solder, Solder Tags, 3-way Strip, Aerial/Earth Strip, Rubber Grommets, Knobs, Fibre Washers (2) for mounting $C_a$.

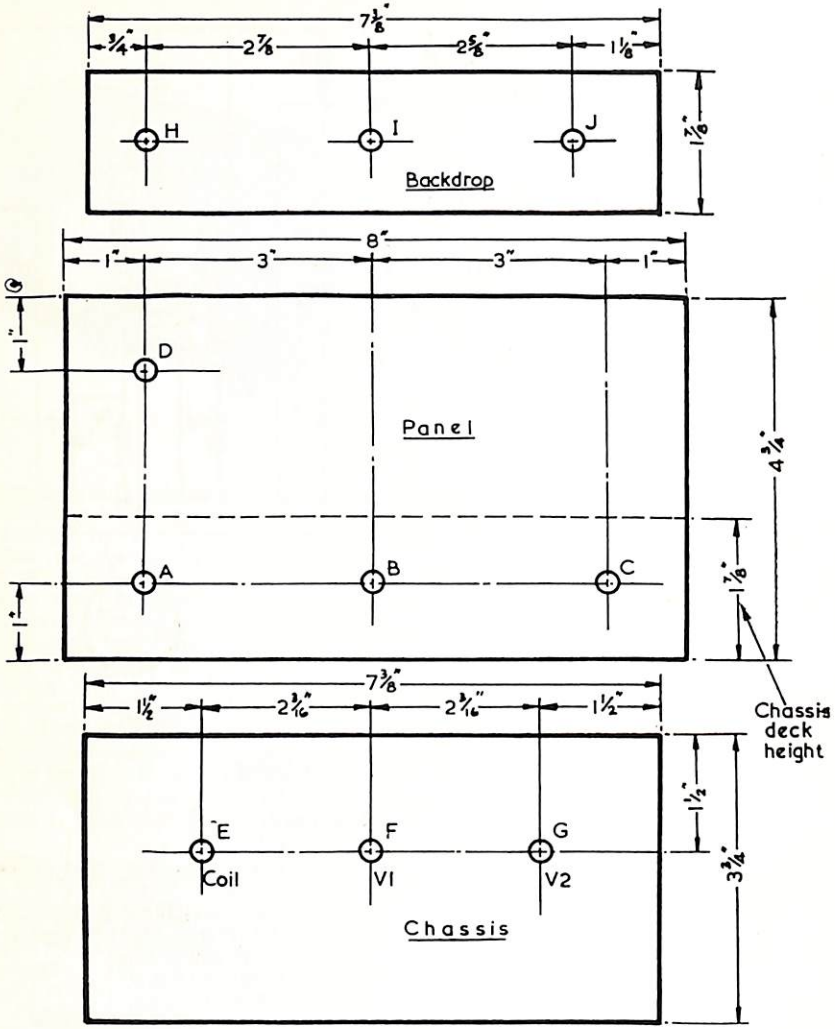



Fig.2
Drilling dimensions of chassis panel & backdrop

E209

while the cathode bias voltage is obtained from $R_8$ decoupled by $C_8$, both connected to pin 7 of the valveholder. The anode load resistor is $R_7$ and the phones are connected to the anode via $C_7$. This last condenser must be of the 350 volts working type as a precaution against the phones becoming "live" through the possible breakdown of a lower rated component. Provided this precaution is observed there is no danger inherent in this portion of the circuit. It is recommended, of course, that this condenser should be that specified, and most certainly not one of the surplus components which quite probably has deteriorated through long, and often bad, storage conditions. So much for the circuit—we now progress to the initial stages preparatory to wiring up the actual circuit.

**Initial Practical Preparations**

Obviously, the first thing is to obtain the components that are specified in the component list. For younger readers whose available cash may be limited, it should not be forgotten that this receiver is capable of being constructed in stages, i.e., as a one-valver in the first instance. Ideally, the tools required are—small pliers, screwdriver, wheelbrace complete with drills, a chassis punch complete with tommy bar for valve-holder holes, soldering iron (preferably of the pencil bit type) and, of course, solder (Multicore). A centre punch and scriber would also be desirable if available.

From Fig. 2, all the information required regarding drilling details may be obtained. As received, the front panel and chassis, together with the cabinet, are separated, i.e., not bolted together. First, drill the front panel as shown, holes A, B, C and D. To do this correctly, lay the panel face downwards on a soft piece of paper so that the paintwork is not scratched or damaged. Next, measure and mark, preferably with a pencil, on the rear face of the panel. Then, after centre punching the drilling positions, drill the required holes. Remembering that these holes must also coincide with the chassis front wall, carefully hold these together in the position they normally occupy when bolted together and use these holes as markers for the chassis wall. Alternatively, take the chassis wall measurements direct from Fig. 2. Having drilled both the panel and the chassis wall, these holes must now be enlarged sufficiently to take the various condensers and the potentiometer. This may be done either with a file, in which case it is apt to be rather laborious, or, better still, with a $\frac{3}{8}$" bit fitted into a carpenter's brace—if one is available. The hole edges are then cleaned off with a small file. The chassis backdrop should next be similarly treated as shown in Fig. 2. Finally, the chassis deck itself should be marked as previously described, punched and drilled and the chassis cutter brought into operation.

Drilling, etc., completed, we now proceed with bolting and fixing the various components into position. Commence with the valve and coil holder. A careful study of the drawings will reveal the manner in which this is done. Mark the fixing holes, drill and bolt into position. When bolting into position, the valveholder earthing tags should be fixed into place on the bolt, and under the nut. Thus, each valve has its own earthing point.

The small bandspread condenser should now be fitted to both the panel and chassis; this will hold these together while fitting the other components into position. Next, fix the potentiometer and the remaining variable condensers in position, except $C_a$.

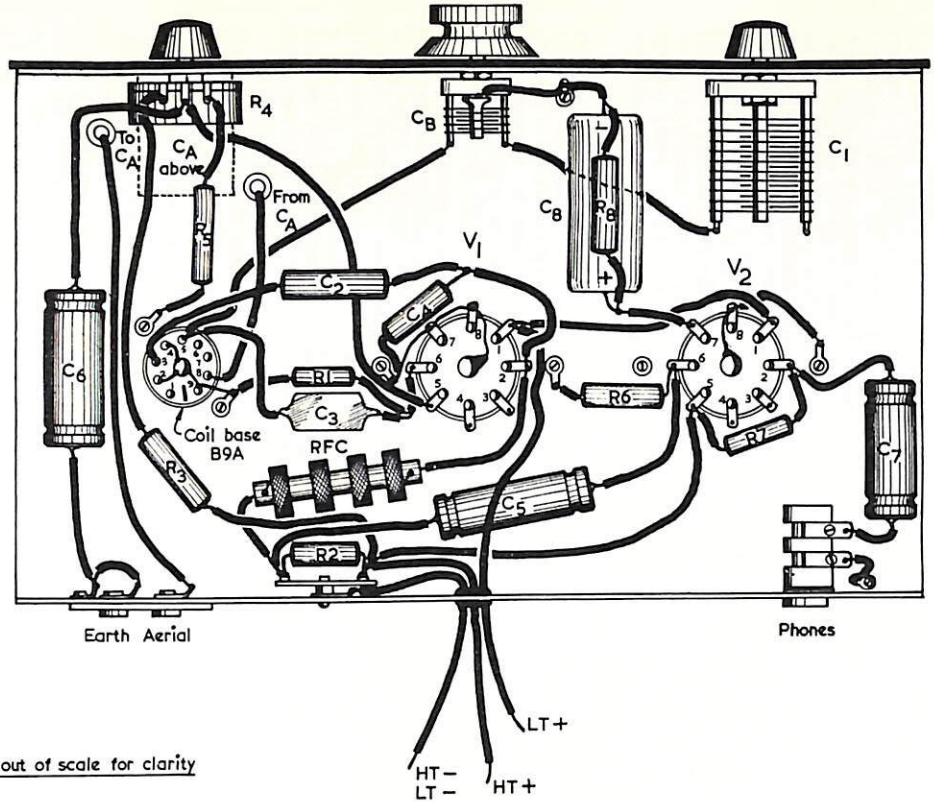
With the condenser $C_a$, it is of the utmost importance that this should not be earthed to the panel at any point, therefore the fibre washers (see Component list) should be placed over the spindle at both the rear and front of the panel, in order to see that no contact is made with the panel.

Turning to the backdrop (rear wall of the chassis), place in position the rubber grommet and secure the phone jack (see drawing). The paxolin aerial and earth strip should now be placed in position so that the aerial bolt is centred within the aperture already drilled; it should *not* be touching the metal chassis otherwise all the signal will be going "down the drain", i.e., the aerial will be earthed. The outside bolts of this paxolin strip should be bolted to the chassis, the outside one (looking at the underside of the chassis) being used as an earth connection. A small three-way tag is also mounted on the backdrop.

This, then, completes the first instalment at the stage where, the circuit having been briefly described and the drilling and assemby completed, we are now in a position to continue with the actual wiring-up details together with the power unit description.

Obviously, as a first consideration, the possession of a good quality soldering iron —preferably of the electric type—is of paramount importance. Although this involves some capital outlay at the outset, it will last for many years—being virtually a necessity in the workshop, and without which it is not possible to construct even the most simple modern receiver.

Apart from the iron already mentioned, the other tools required are a pair of side-cutter pliers, fairly small ones, and a "Bib" wire stripper. For materials, lengths of various coloured PVC wire (in effect, plastic covered wire), a length of systoflex (flexible insulating material for covering bare wire ends of components), and last but not least, something not often mentioned in radio periodicals—the humble piece of rag. This latter item is very necessary for wiping the iron from time to time thus removing old solder and accumulated dirt, etc. A further point worth mentioning to the beginner is the provision of a suitable iron stand on which the heated iron can be placed, both for safety and convenience. It must, of course, be of metal, and a small length of aluminium bent into the shape of a letter L (viewed sideways), bolted onto the bench and with a cut-away notch in the centre (see Fig. 10), would serve admirably.




Components shown are out of scale for clarity

G OC2

*Wiring diagram of the "Meteor" Mini-Receiver. Note: Pin 4 of $V_1$ should be wired to earth tag alongside pin 2 and not left blank as shown. $R_1$ should be wired as shown in Fig. 6.*

**Wiring the Receiver—The First Stage ($V_1$)**

Although only the wiring of the first valve is dealt with in this section, the heater wiring should be completed for both valves at the outset. The two valveholder pins (No. 1), should therefore be connected together via a suitable length of PVC wire. From pin 1 of $V_1$, a nine inch length of wire should be taken out through the grommet. This lead will constitute the l.t.+ input when connected to the power unit later. Pins 8 of both valves should now be soldered to the nearest soldering tags which are fastened under the respective holding bolts of the valveholders. The same length of wire should also be soldered to the central metal spigot of the holder. This latter operation ensures that an earthed screen is between the grid and anode pins of the valve. This completes the heater wiring.

Pin 7 should now be soldered to pin 8. To pin 2, solder one end of the r.f. choke, the other end of which goes to one tag on the 3-way strip. Having done this, return to pin 2 and solder both $C_2$ and $C_4$ to it. The other end of $C_2$ is now connected to the coil (see Fig. 3). $C_4$ is then taken to the earth tag. No. 3 pin is left blank. Next, pin 5 is taken, via a suitable length of PVC wire, to the centre tag of the potentiometer ($R_4$). Pin No. 6 is soldered to $R_1$, the other end of which is taken to chassis, and $C_3$ connected from pin 6 to the coil (again see Fig. 3). This completes the actual valveholder soldering operations.

The next step is to wire up the tag strip (see Fig. 9). On the same tag holding the r.f. choke, solder both $C_5$ and $R_2$. Now $C_5$ has to be connected at the other end to the phone jack—assuming that the receiver is being built as a one-valver in the first instance. This being so, the wire ends of this condenser must not only be cut to length but must also be covered with a length of systoflex in order to provide some measure of insulation. For connections to the phone jack see Fig. 8, where it will be seen that $C_5$ is wired to the tag furthest from the chassis wall, while the other tag is

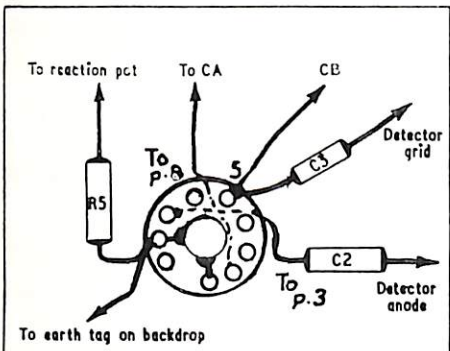



FIG.3. COIL CONNECTIONS

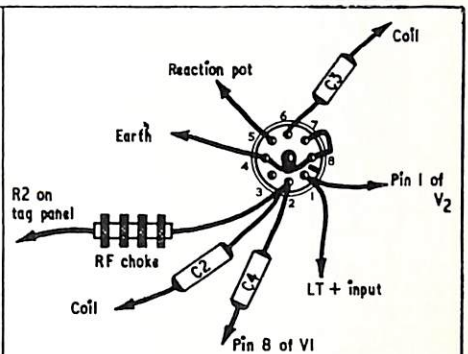



FIG.4. DETECTOR BASE WIRING

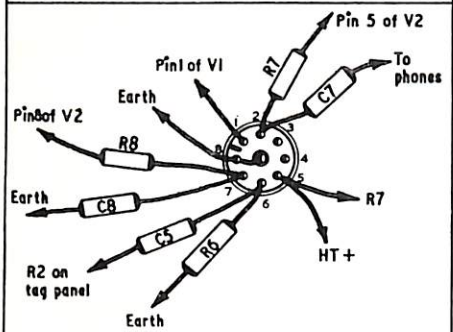



FIG.5 BASE WIRING OF V2

G217

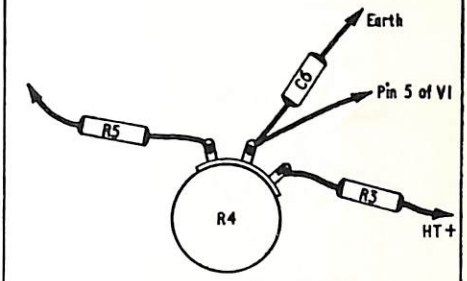



FIG.6. REAR VIEW OF R4 (POTENTIOMETER) CONNECTIONS

taken to chassis. There are four tags on the phone jack altogether, but the two we are concerned with are those comprising the long spring-metal portions which extend through the cut-away portion of the bakelite body. The remaining two tags are not required in this circuit. The resistor $R_2$ is taken to the other outer tag of the strip (again see Fig. 9). To this same tag connect a nine-inch length of wire, taking the other end of this through the rubber grommet. This will constitute the h.t.+ input to the receiver. Also to this tag solder

Dealing with coil connections next, most of which are already done in the foregoing instructions, a study of Fig. 3 will make these clear.

To the same earth connection as $C_6$, take a wire direct to the earth tag on the aerial/earth strip. From the same pin to which $C_3$ has been connected, solder a length of PVC wire to the variable condenser $C_b$; this latter is the small condenser occupying the central position in the drawing. From the other side of this condenser solder a further length to $C_1$, the larger variable condenser. A study of the drawing will show how this has

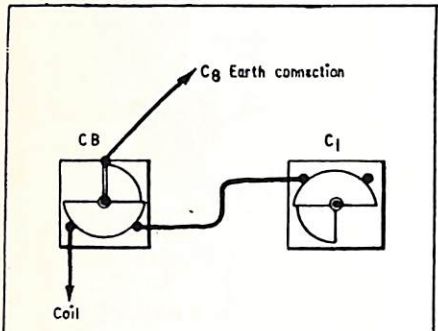



FIG.7.VARIABLE CONDENSER WIRING

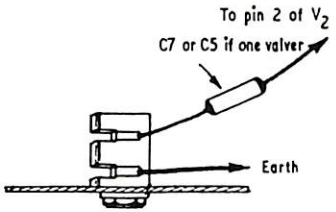



FIG 8 PHONE CONNECTIONS

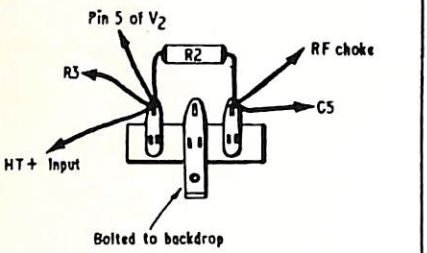



FIG.9.TAG WIRING

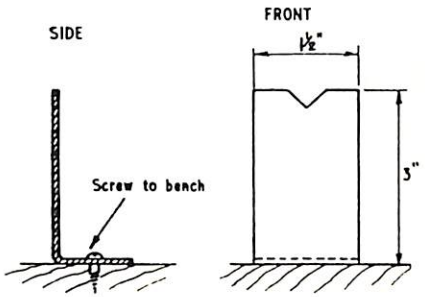



FIG.10.SIMPLE SOLDERING IRON STAND

G218

$R_3$, the other end of which is then taken to the right-hand tag on the potentiometer ($R_4$), for which see Fig. 6.

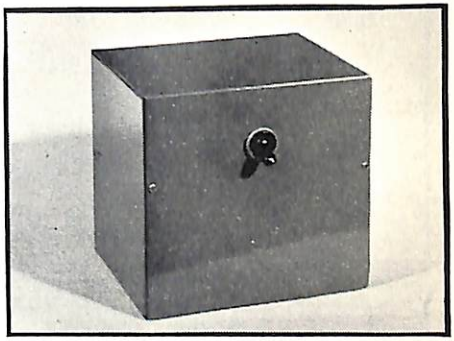
Still dealing with $R_4$, to the centre tag, on which we already have a wire from pin 5 connected, also solder $C_6$—the other end of which is connected to the earth tag contained on the aerial/earth strip bolted to the chassis rear wall. To the left-hand tag on $R_4$ (Fig. 6), solder the resistor $R_5$, the other end of which is then taken to the coil earth tag (see Fig. 3).

been done. The only remaining coil connection, apart from pins 2, 4, 9 and spigot to chassis, should then be wired to pin 8 and is taken through a hole drilled in the chassis deck and soldered to the tag fitted to the stator plates (i.e., those that do not rotate), on $C_a$. From the rotor plate (i.e., those that rotate with the spindle) connection, solder a further length of wire through the chassis and thence to the aerial tag on the aerial/earth strip.

Lastly, to the earthing tag on the backdrop, solder a nine-inch length of wire and take this through the rubber grommet. This is both the l.t.— and h.t.— connection to the receiver.

This completes the first stage of the receiver, but before we can try it out on the air in order to ascertain that this part of the set is working, and before wiring up the second stage, we must next obtain or construct the power unit.

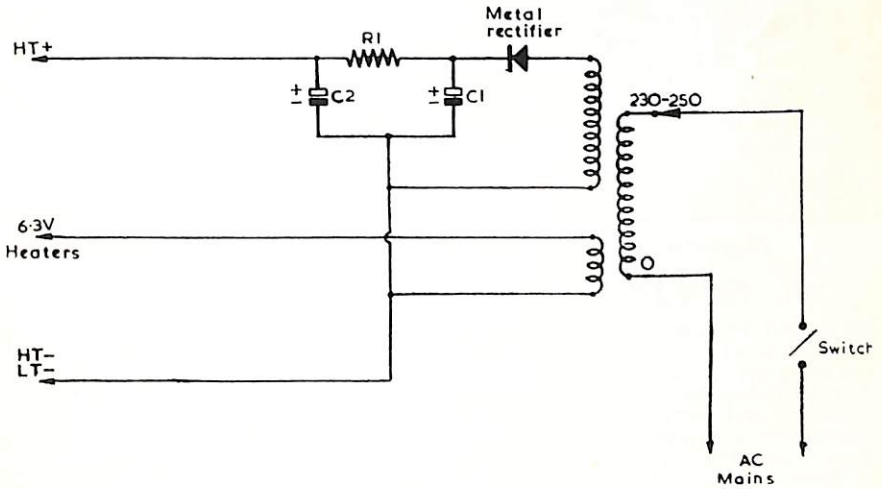
# The PU1 Power Unit



The R.C.S. Power Unit type PU1 is an ideal unit for the beginner. Purchased in component form as available cash permits, and constructed by the beginner himself, it considerably assists the enthusiast in a practical manner to obtain some knowledge of a.c. mains power packs and power supplies. Once constructed, it is housed in the attractive grey metal cabinet illustrated herewith.

A switch is provided on the power unit panel for on/off operation, and the power supplies to the receiver are taken via a rubber grommet protected aperture in the rear of the case. A.C. power input is provided for in a like manner.

The PU1 unit will provide some 120 volts at 20mA and 6.3 volts heater supply at 1.5 amps. This rating is adequate for the Mini-




E70

Fig.11
Circuit of RCS power unit type PU1

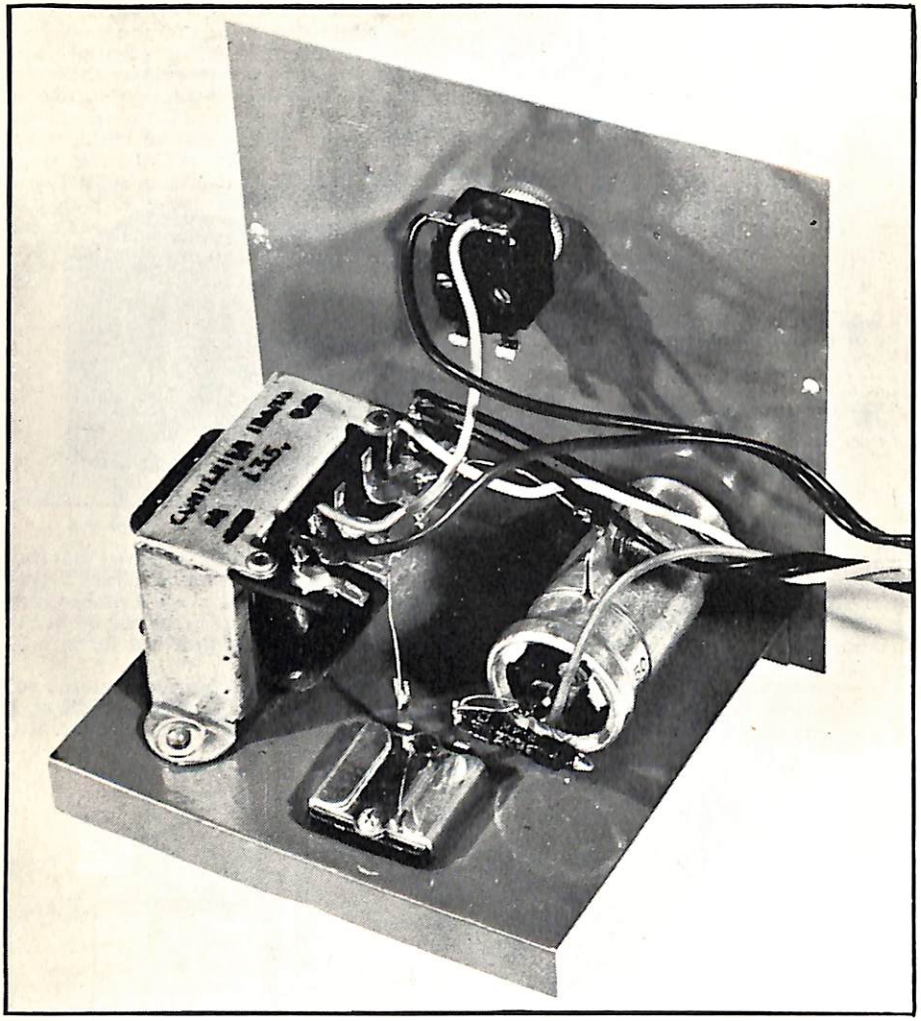


*Illustration showing the component layout of the type PU1 power pack.*

Receiver and the power unit will be found to run cool at all times—a sure sign that it is not being overworked.

The PU1 may be purchased as a completely built and tested unit, but for those who prefer to construct it themselves, the following complete instructions are given. The theoretical circuit is shown in Fig. 11 and this, together with the illustration shown herewith, will give the beginner most of the information regarding component layout etc.

**Assembly**

Mount the mains transformer to the chassis by means of two screws and nuts provided, ensuring that washers are placed on the screws both above and below the chassis. (See photograph for orientation of the components). Secure the contact cooled metal rectifier and the smoothing condenser earthing clip to the chassis in the same manner. Place the smoothing condenser $C_1$ and $C_2$ (both these condensers are contained within a single metal can) into the earthed clip.

Through the holes at the top of the clip place a screw and secure with a nut, ensuring that a small earthing tag has been placed under the screwhead before so doing. Place into position, and secure to the front panel, the on/off switch, in such a manner that the coloured contacts are uppermost.

This completes the assembly instructions.

**Wiring the PU1**

It will be noted that all the metal contacts of this unit are colour coded in order to greatly simplify the wiring instructions and to assist the beginner as much as possible. Careful attention to the following instructions will ensure that no possible mistake can occur with respect to the wiring process.

Step No. 1 With a short length of bare wire, solder together the WHITE tag of the mains transformer to the WHITE tag of the metal rectifier.

Step No. 2 Solder a short length of wire from the RED tag of the metal rectifier to the RED tag of the condenser. Also to this latter tag, solder one end of the resistor $R_1$ (2.4kΩ). Connect the other end of this resistor to the BLUE tag of the condenser. (Note: The wire ends of this resistor must, of course, be cut to a suitable length before soldering—see photograph).

To the RED tag of the condenser also solder one end of a length of RED covered p.v.c.

Step No. 3 Solder one end of a length of bare wire to the RED tag of the transformer and from there continue the wire to the GREEN tag of the transformer, ensuring that it touches no other tag on the way, and solder to the GREEN tag, then continue the wire to the earthed solder tag mounted on the condenser clip and solder the wire end to this tag.

Step No. 4 Cut two lengths of BLACK p.v.c. wire, bare and solder together one end of each. Solder these two joined ends to the GREEN tag of the transformer.

Step No. 5 Solder a length of ORANGE p.v.c. wire to the BLUE tag of the transformer.

Step No. 6 Connect one end of a short length of p.v.c. RED wire to the UNMARKED tag of the transformer and the other end to the BLUE tag of the on/off switch.

Step No. 7 Solder an end of one of the BROWN mains lead wires to the RED tag of the switch and the end of the remaining unconnected mains lead to the YELLOW tag of the transformer.

This completes the wiring instructions for the PU1.

Feed through the right hand aperture of the outer casing, looking at the case from the front panel side, the mains input wires, firstly placing into position a rubber grommet in order that the metal edges of the hole do not cut through the plastic outer covering of the wires. Through the remaining aperture feed the power output leads, BLACK, RED & ORANGE, similarly placing in position the remaining rubber grommet. The front panel may now be secured to the casing by means of the two small self-threading screws.

The following will be the colour code of the leads now protruding through the rear of the case. Mains leads—BROWN; h.t.+ will be RED; l.t.+ will be ORANGE and the two black leads will be the h.t.— and l.t.— connections.

---

# PUTTING THE ONE-VALVER ON THE AIR

Having completed the power unit, as previously described, we may now proceed to air-test the Mini-Receiver as a one-valve receiver. Before doing so, however, first insert the valve (EF41) into the valveholder. Next, insert the phone plug into the jack and connect the aerial and earth to the appropriate terminals on the aerial earth strip (crocodile clips would be an advantage here). Plug in one of the coils—the Medium Wave one would do (Coil No. 2)—although it is not important which one is finally chosen, except that the signals received on medium waves are of course more reliable than those on short waves, the latter depending greatly on ionospheric conditions.

To connect the Power Unit type PU1 to the receiver, connect the Red (h.t.+) wire

to the tag strip (see Fig. 9); connect the Orange (l.t.+) wire to the wire from pin 1 of $V_1$ valveholder; and both the black wires are soldered to that wire going to the earth tag on the backdrop. Connect the power unit to the mains and switch on.

Having described the wiring up of the detector stage, readers who have progressed thus far will, by now, be ready to proceed with the second, or audio, output stage. The addition of this will, of course, greatly increase the audio output of the receiver, so that many stations which up to now have been barely audible will be heard with much greater strength and clarity. In effect, then, we are really increasing the range of the receiver as a whole.

**Wiring the Receiver—the second stage $V_2$.**

Before commencing the actual wiring of this stage, we must first disconnect $C_5$ from the phone output jack, assuming of course that the receiver has been completed as a one-valver and is working satisfactorily. The connection from the jack to earth (chassis) is left as connected.

The now disconnected end of $C_5$ is now taken to pin 6 of $V_2$, also to this same pin $R_6$

TABLE 1

| | |
|---|---|
| Anode $V_1$, 80V | Anode $V_2$, 85V |
| Screen $V_1$, Nil ($R_4$ at min. setting) | Screen $V_2$, 90V |
| | Cathode $V_2$, 1.95V |
| H.T. Input, 90V at 16mA ($R_4$ at min. setting) | |

All above readings taken under no signal conditions, $R_4$ at zero, phones not inserted. Current with $R_4$ at max. setting, 20mA, conditions as above.

is soldered; the other end of this resistor being taken to the earthed tag alongside valveholder. The cathode resistor $R_8$ is connected between pin 7 and the earthing tag shown. Next, to pin 7 solder one end of the cathode bias condenser $C_8$; this should be the end of the condenser marked plus (+), or, should the specified component not be used, it may be simply coloured red. The other end of this condenser is now soldered to the earthed connection of $C_b$ (see drawing). The next step is to run the h.t.+ line into this second stage, this being done by soldering a length of PVC wire from the h.t.+ input connection to pin 5 of $V_2$ (see Fig. 9). Having done this, connect one end of $R_7$ to pin 5 and the other end of this resistor to pin 2 of the valveholder. Also to pin 2 solder one end of $C_7$, and take the other end of this to the phone jack connection from which $C_5$ was removed (see Fig. 8). Both connecting wires of $C_7$ should be covered with suitable lengths of systoflex for insulation purposes. This completes the wiring details of the second stage and therefore the whole receiver. However, the set as a whole is not yet complete, and we describe in the following paragraphs those final touches which make all the difference to both the visual appearance and the operating efficiency of the receiver. We also include a voltage table for those beginners who may be fortunate enough to be in possession of a test meter. The voltage readings given are those obtained from the actual prototype, with a 1000Ω/V meter (1mA F.S.D.).

**Front Panel Accessories**

To the front panel we must now affix the Panel-Sign transfers as the next step to the completion of the receiver. (Sets No. 3 and 6). All the dials required are included in the latter set, whilst the wording transfers will be found in the former set. Although only a few of the total number of transfers are used here, the remainder will be found extremely useful in making other constructional items. Once purchased, they will last the average constructor a very long time.

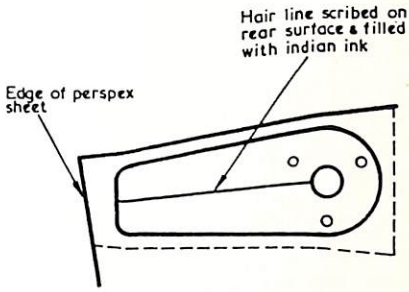
The first transfer to affix to the panel is the full vision dial which is used for Bandspread purposes. Full instructions for fixing these are given with every set supplied. With the prototype, no varnish was used as very little heat is generated internally, and therefore the ordinary gum contained on the rear of each transfer is sufficient for the purpose. Having affixed this dial, allow to dry for at least two or three hours before removing the thin tissue paper. With this operation completed, proceed to fix both the lower panels followed by the upper transfer. In all this, of course, one should ensure that these panels are mounted as square as possible in order to obtain a tidy and neat appearance. With all tissue paper removed, and the transfers thoroughly dry, cut out the required wording and fix these over the control panels. Next, fit and screw into position the control knobs in the correct positions. These are as follows: Aerial Trimmer-pointer set at position 1 with the condenser vanes fully meshed. Reaction-pointer at 0 with potentiometer in fully anti-clockwise position. Bandset-pointer at 10 with condenser vanes fully meshed. The correct position of the Bandspread dial, when completed (see following paragraph), should be with the pointer at 50 and the condenser vanes at half mesh. If preferred, of course,

the large dial could be used as the Bandset control and the smaller panel as the Bandspread. This is merely a matter of preference and only involves the changing over of the two variable condensers so that the large Bandset condenser occupies the central position of the chassis. Should this be done by the beginner, there is no reason why the dial should not be calibrated against known stations by marking the dial with ordinary indian ink.

The "Meteor" transfer should now be fixed. This is obtainable from most bicycle stores, where they are sold for applying to cycles.

The 'Perspex' cursor must next be made and fitted. This is shown herewith. The 'Perspex' sheet can be easily marked by scoring the outline of the cursor with the edge of a scriber or some other sharp pointed instrument. It is a good plan to use one edge of the supplied sheet as one side of the actual cursor (see drawing). This should now be cut around with a small saw, allowing about a tenth of an inch margin from the actual outline. This margin should then be filed away after the cursor has been cut from the sheet. The next step is to mark and drill the spindle aperture. For this, a centre punch and a quarter inch drill are required. The fitting of the cursor to the knob is largely a matter of screwing the 'Perspex' to the knob. In the prototype this was done by three holes through the 'Perspex' and into the rear face of the knob. Into these holes were fixed Parker-Kalon self-tapping screws, although ordinary wood screws, preferably of the flat-headed type, would suffice. Before drilling these fixing holes, however, it is as well to fit into the spindle aperture and the knob, a short length of old spindle, or that removed from $R_1$, as this will probably be too long as supplied. This is important if the cursor is to run 'true' over the full vision dial.

We have now completed the constructional details of this receiver and it remains for the beginner to explore the various bands at his leisure.




Details of cursor

E224

# The NIGHTRIDER Communications Receiver

HAVING BUILT ONE OR PREFERABLY TWO of the receiver designs so far described in this book, and having operated them for some time over the various bands, the enthusiast will sooner or later turn his attentions to the possibility of constructing and using a superheterodyne receiver. It must be pointed out however that such an undertaking is *not* recommended for the *absolute* beginner, some experience being necessary in the construction of "straight" or t.r.f. receivers before such a task is undertaken.

The design discussed here, and later to be described, is a communications receiver capable of being built by those who have some experience in radio constructional work and practice and who are able to accurately follow a circuit diagram and to relate instructions into accomplished fact. This is assumed by the writer and therefore *no point-to-point* instructions are given, although a clear and adequate sequence is set out which, together with the various diagrams and illustrations, will make the construction a reasonably easy matter for the average home constructor.

Before describing the actual circuit in detail, the writer feels that the intending constructor should be given some background concerning the factors which led to this design and the particular components specified. In this manner, those considering the construction of this receiver will be fully informed of the "reasons why" and, in addition, will be able to assess the extent to which they are committing themselves both in respect of cash outlay and constructional ability.

### The Design Plan

Briefly, the design is such that it can be firstly constructed as a 5-valve superhet capable of being simply converted into a 7-valve receiver at a later stage when both time and, often more important, available cash permits. In this manner, those enthusiasts who are tackling their very first superhet will have their path smoothed somewhat in that the whole project is easier than taking on a 7-valve design from a standing start. Additionally of course, a 7-valve design once completed, and with an inherent fault, will be much more difficult to "get going" than will the lesser design.

The full 7-valve circuit is shown in Fig. 1 and it will be seen that this comprises the following stages:— r.f.; frequency changer; i.f.; a.m. detector/a.g.c.; product detector b.f.o.; output and power stages. As a 5-valve design, both the r.f. and the product detector stages may be omitted from the circuit in which case, apart from the lack of an r.f. stage, the receiver will not have a beat frequency oscillator with which to read c.w. (Morse code). For many, unable to read the code, this will not present a great disadvantage, although single sideband tranmissions on the amateur bands will also be unintelligible until such time as the product detector is included in the circuit.

The full list of components for the 7-valve receiver is shown alongside the circuit and all these should be obtained, less the two valves in question and their associated components.

### The Components

Great care has been exercised in the selection of components for this receiver. A good communications receiver is virtually just as good as its components will allow—other things of course being equal. It is of little use specifying or using inferior, or so-called "surplus", components—many of the latter have been stored for long periods in unfavourable circumstances with the attendant deterioration that inevitably

follows. In any event, a communications receiver is really a scientific instrument and, like all such instruments, costs quite a lot of money—it is therefore only "spoiling the ship for a ha'porth of tar" to include inferior components with all the attendant disappointments that may follow.

From the components list it will be gathered that only the latest and best available types of components, currently available on the market, have been specified. The design, as such, is fully up to date both with respect to current circuit practice and with the actual types of components—it being of little use specifying out of date or older types in a modern design.

It should be further pointed out here, to the intending constructor, that these components (and therefore the entire receiver) are not by any means cheap. One cannot expect to construct, from a standing start, a quality modern communication receiver for only a few pounds, and a glance at current advertisements in the radio press imparts some idea of the costs involved when purchasing such equipment either new or second-hand.

From the foregoing, then, and from the following discussion on components, the constructor will obtain some idea of the factors involved, both with regard to cost and constructional ability *before proceeding further with the project.*

## The Dial

The dial and drive mechanism specified has been selected for this receiver because it is, to the best of the writer's knowledge, one of the best high grade assemblies designed for instrument applications available to the home constructor. Moreover, it conforms to modern communication receiver design, having a large horizontal scale (illuminated from behind by two 6.3V bulbs) which is capable of being calibrated over five differing frequency ranges if so desired. The main pointer has a horizontal travel of 7 in. and a circular vernier scale (mechanical bandspread) is marked for 100 divisions, this latter scale rotating five complete times for one single traverse of the main pointer. The bandspread scale, read in conjunction with the main pointer will, therefore, provide a total bandspread reading of 500 divisions. The bandspread scale is always at zero when the main pointer is set at either 100, 200, 300, 400 or 500 there being no backlash, it is an easy matter to calibrate the bandspread scale and thus return, at any time, to the *exact frequency* required. This feature is, of course, a cardinal point in the design and practical application of a communications receiver. A receiver which, although perfectly sound electrically, has a badly designed dial in which backlash is inherent, or which has a cramped scale or insufficient drive reduction, is virtually useless in the practical sense.

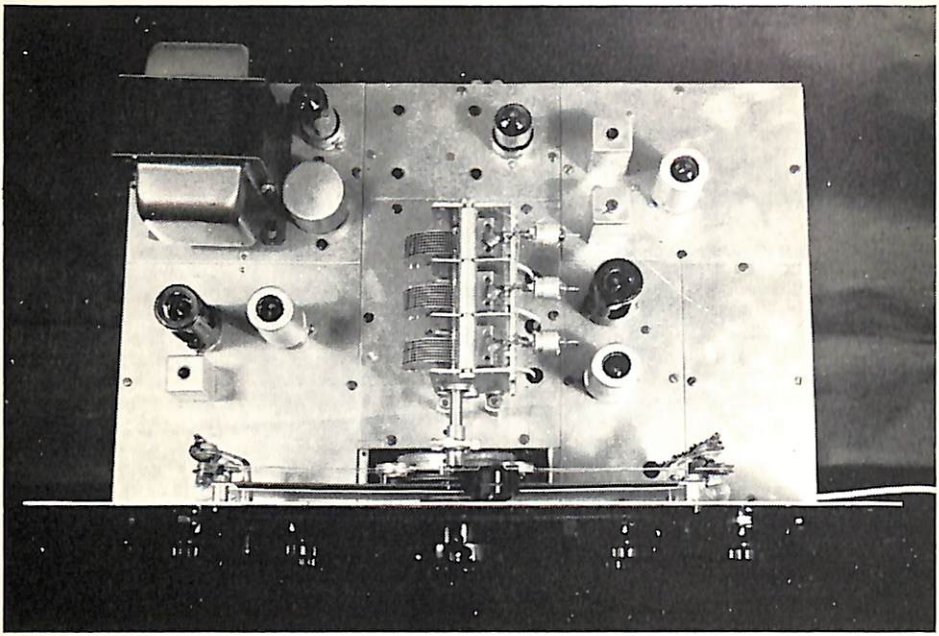
The movement of the dial specified is gear-driven and flywheel loaded, giving a smooth and positive drive having a reduction ratio of 110 to 1.

A directly calibrated dial is not only much preferred by the writer but is also in conformity with current trends. A receiver having a numbered circular dial, even when fitted with a vernier block, suffers from the great disadvantage that separate graphs must be prepared and maintained for each individual range, frequent reference to these graphs having to be made during the periods of operation. In any event, other dials considered for this design, whether of the latter type just mentioned or of the 180° full-vision type (for direct calibration) suffered from the disadvantages that they had (a) insufficient reduction—10 to 1 being the most one could obtain or (b) were not horizontal or (c) not gear driven.

## Valves

The whole valve line-up of this receiver has been confined to the B9A Mullard range, these being the latest types available and excellent for the purposes for which they have been included in the design. In this manner, not only has the use of various valveholders and valve sizes and classes (i.e. B7G, I.O. etc.) been obviated, but also the great advantage has been gained that the inclusion of the new frame grid valves has been possible whilst still retaining the overall conformity of valveholder types. This considerably assists in respect of the amount of chassis room still available for further additions to the circuit *after* the present design is completed. More will be said about this latter point in a later paragraph.

Theoretically, it can be shown that the gain of any r.f. or i.f. amplifier is approximately proportional to the mutual conductance of the valve used in such an amplifier. The conventional type of valve often specified in some receivers is, for example, the old octal based 6K7 having a mutual conductance of around 2mA/volt, whilst the more modern 6BA6 has a higher gain, when used as an r.f. amplifier, with a mutual conductance of some 4.4mA/volt. In contrast to this, the EF183 variable-mu r.f. pentode, used here in both the r.f. and i.f. stages, has a maximum mutual conductance of some 13mA/volt—three times the figure provided by the 6BA6 and seven times the figure for the 6K7.



*Above-chassis view of the completed receiver. Note the dial light assemblies (fitted under the dial securing nuts) and the flywheel loaded geared dial drive.*

Used as an r.f. amplifier, the EF183, in addition to providing very high gain, also has the advantage that the signal-to-noise ratio at the stage output is considerably greater than that available at the output of a similar stage using a more conventional valve. As the r.f. stage immediately precedes the frequency changer valve, the noise voltage developed in the former stage must be very much less than that of the frequency charger if there is to be an appreciable improvement in the signal-to-noise ratio, and this requires a valve having a high mutual conductance. The EF183 admirably fills the bill with respect to this requirement.

The ECH81 triode-heptode is used twice in this design, in the first instance as the frequency changer and in the second as the product detector/b.f.o. As a frequency changer, this valve performs admirably over the range of frequencies for which the receiver has been designed; whilst, as the product detector/b.f.o., it has been selected (a) in order to limit the valve types used to a minimum and (b) because the circuit shown is preferred by the writer to that of the more conventional double-triode versions.

The ECC82 double-triode is used here, one half as an a.m. (amplitude modulation) triode detector and the other half, diode connected, as the a.g.c. (automatic gain control) valve.

The ECL83 triode-output pentode has also been included, the triode portion functioning as the first a.f. (audio frequency) amplifier and the pentode section as the final a.f. stage. With its maximum output of some 2.5 watts this valve ensures that an adequate audio output voltage is available for all normal requirements.

The EZ81 full wave rectifier provides adequate power for this receiver design and, under the conditions shown here, is working much below its rated maximum.

**Coilpack**

It was considered desirable to include a manufactured coilpack (DENCO type CT7/B) for the reasons that (a) this unit is more efficient than one of the home-made variety, (b) the final results of individually constructed receivers will be standardised with that of the prototype, (c) the connections to be made by the constructor are simply arranged and easy to describe and (d) the frequency coverage will be largely standard.

Of the few coilpacks available on the market, it was decided that the one specified was ideal for the purpose. Only three short wave ranges are included although it is

perfectly and easily possible to purchase a further two ranges which may be added to the existing rotary turret, these two further ranges being for the medium and long wave bands. In this manner, some saving of available cash is possible for those not requiring these two wavebands.

A rotary coil turret was considered to be much more efficient than a coilpack employing Yaxley wavechange switching, since the latter variety often exhibits appreciable losses within the switch itself—especially after the switch has been in constant use for a period of time—and because wiring to the tuned circuits is very much shorter. With the turret type used here, silver plated spring contacts are employed and only one set of coils is switched into circuit at one time, the remainder being physically far removed from the tuned circuit. In this manner, no possible inter-action is caused between individual coils of the pack. Moreover, each individual coil section, when switched into circuit, is adequately screened from the others. Thus the r.f., oscillator and mixer coils of any one waveband are entirely segregated. The range of the coilpack is as follows:— Range 1, 1.5 to 4Mc/s; Range 2, 4 to 12Mc/s and Range 3, 10 to 30Mc/s.

### Capacitors and Resistors

As mentioned previously, all of the capacitors and resistors used in this receiver are quality components. All of the 0.01 and 0.1μF capacitors are of Mullard manufacture, these being completely sealed and therefore impervious to damp, as well as being tropicalised and therefore unaffected by any reasonable amount of heat. The resistors are, in the main, of 5% tolerance and ½ watt rating.

### Mains and Output Transformers

These two components have been specially designed for this receiver and both are adequately rated for their present applications. The mains transformer (see Components List) is under-run in this circuit, i.e., working far below its capacity. This is deliberate and is explained under the sub-heading "Later Additions".

The output transformer is physically small in order that it may fit comfortably into the layout and because, in a communication receiver, exceptionally high audio quality is not (generally speaking) required, the accent being on communications and not "near hi-fi" results. It is correctly matched to the anode impedance of the output pentode.

### Chassis and Cabinet

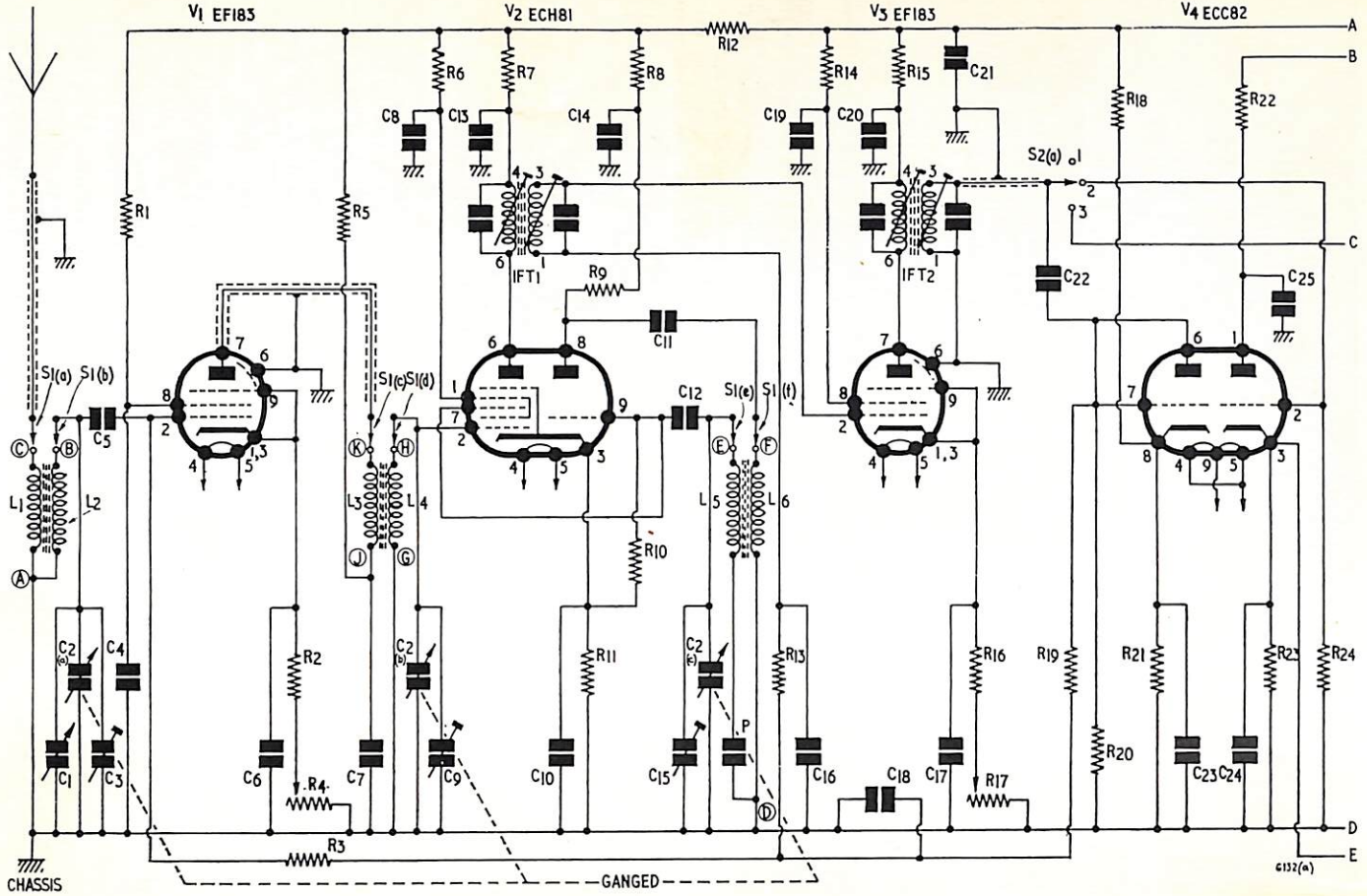
These have been constructed to the author's specification and the chassis itself is known as a "free deck" type. Such a type confers advantages over the more conventional chassis in that the deck itself is composed of small aluminium plates, each plate containing one or more sections of the circuit. Because of this, (a) later additions or modifications are easily carried out since only a small part of the chassis, if any, has to be scrapped; (b) extra rigidity is imparted to the chassis deck as a whole in that each individual plate is screwed to an underlying screen, thereby avoiding chassis "whip" under the weight of components; (c) each section of the circuit is capable (indeed this is the main essence of the plan) of being almost completely constructed *outside the main receiver frame* and of then being screwed into position; and (d) consequent upon (c) the whole receiver may be easily and compactly constructed.

### Later Additions

Once the constructor has successfully completed the 7-stage design shown here, the first addition to be aimed at when time and available cash permit is a further i.f. stage. This could well be placed between the present i.f. stage and the detector, suitable wiring modifications being made to accomodate this addition. Such a stage could, ideally, be formed by the inclusion of another EF183 pentode or, if less gain is required, an EF80, the base connections of each valve being exactly the same. The best method of achieving both greater gain and selectivity would be to incorporate the former type valve with two i.f. transformers, these latter components being mounted "back to back" together with the required small value coupling capacitor. Loss of gain will result in the use of two i.f. transformers connected in this manner but this will be offset to a large extent by the greater gain of the added valve.

The next addition of importance would be a "Q" multiplier stage centred on the i.f. passband, thus greatly increasing the overall selectivity of the receiver. Such a stage, to be efficient, must include a valve having a high anode impedance and have a coil of high "Q" value wound on, and contained within, a ferrite potcore, these coils being available commercially from home constructor retailers. One of the most commonly used valves for this purpose is the ECC83, a high-mu double triode having a B9A Noval base. With an anode voltage of 100 the anode impedance is of the order of 80kΩ—which is ideal for the present application.

Apart from the addition of an "S" meter or some other visual indication of signal strength such as one of the "Magic-Eye" valves, the best remaining addition would be


V1 EF183
V2 ECH81
V3 EF183
V4 ECC82
R12
R6
R7
R8
R14
R15
C21
R18
R22
C8
C13
C14
C19
C20
S2(a) o1
2
3
IFT1
IFT2
R9
C22
C25
R1
R5
C11
S1(a)
S1(b)
S1(c)
S1(d)
S1(e)
S1(f)
C12
C5
L1
L2
L3
L4
L5
L6
R10
C2
C4
R2
R11
R13
R16
R19
R21
R23
R24
C1
C3
C6
R4
C7
C9
C10
C15
C16
C18
C17
R17
R20
C23
C24
R3
CHASSIS
GANGED
A
B
C
D
E
G132(a)

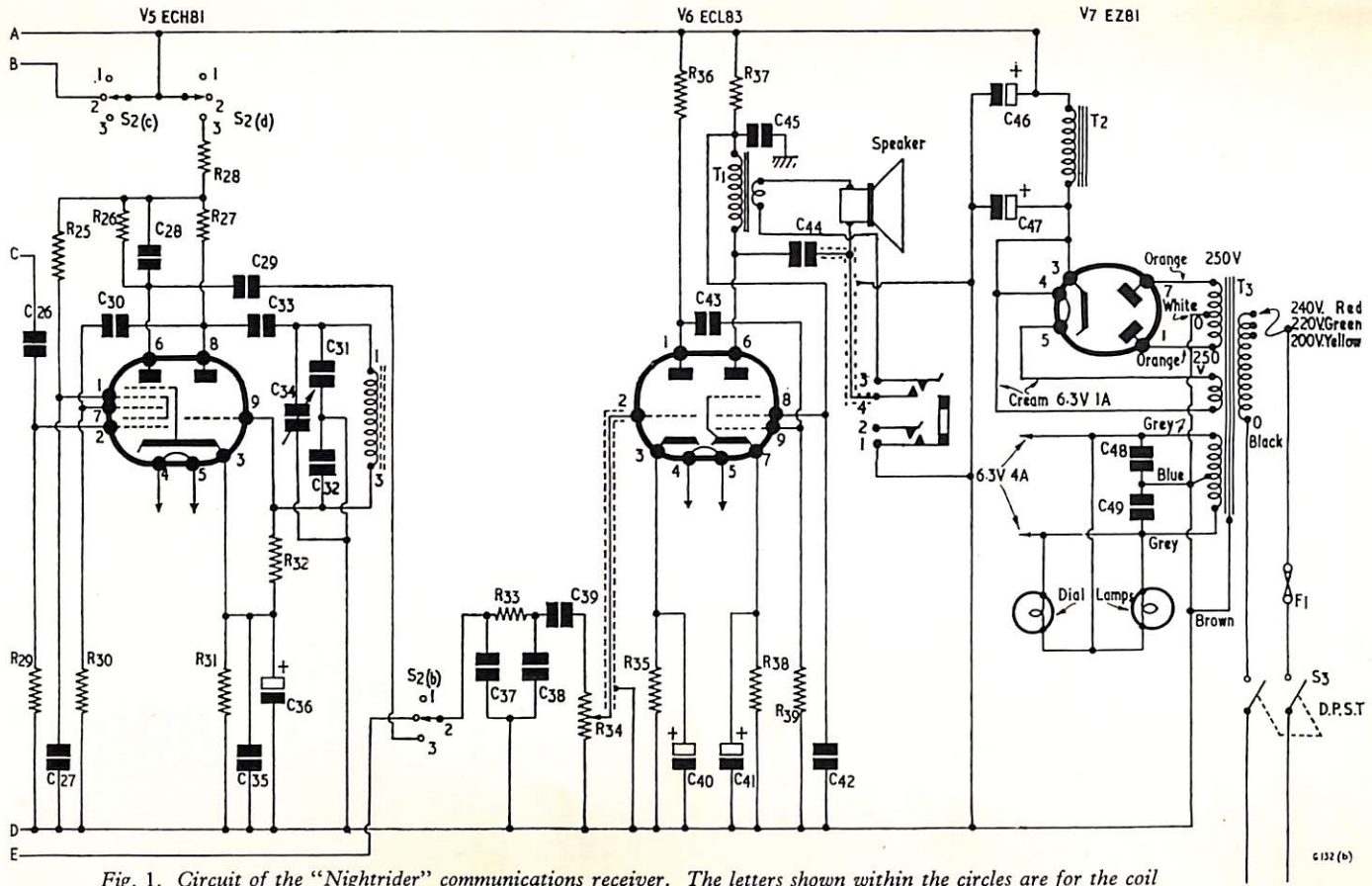



*Fig. 1. Circuit of the "Nightrider" communications receiver. The letters shown within the circles are for the coil turret contacts (see Fig. 2).*

# COMPONENTS LIST

*Resistors* (All ½ watt 5% unless otherwise stated)

| | |
|---|---|
| $R_1$ | 33kΩ |
| $R_2$ | 200Ω |
| $R_3$ | 47kΩ |
| $R_4$ | 5kΩ pot. (r.f. gain) |
| $R_5$ | 10kΩ 1 watt |
| $R_6$ | 22kΩ 1 watt |
| $R_7$ | 10kΩ |
| $R_8$ | 4.7kΩ |
| $R_9$ | 22kΩ 1 watt |
| $R_{10}$ | 47kΩ |
| $R_{11}$ | 220Ω |
| $R_{12}$ | 4.7kΩ 2 watt |
| $R_{13}$ | 47kΩ |
| $R_{14}$ | 33kΩ |
| $R_{15}$ | 10kΩ 1 watt |
| $R_{16}$ | 200Ω |
| $R_{17}$ | 5kΩ pot. (i.f. gain) |
| $R_{18}$ | 390kΩ |
| $R_{19}$ | 1MΩ |
| $R_{20}$ | 1MΩ |
| $R_{21}$ | 3.3kΩ |
| $R_{22}$ | 33kΩ |
| $R_{23}$ | 82kΩ |
| $R_{24}$ | 1MΩ |
| $R_{25}$ | 22kΩ |
| $R_{26}$ | 12kΩ |
| $R_{27}$ | 47kΩ |
| $R_{28}$ | 33kΩ |
| $R_{29}$ | 220kΩ |
| $R_{30}$ | 470kΩ |
| $R_{31}$ | 270Ω |
| $R_{32}$ | 47kΩ |
| $R_{33}$ | 56kΩ |
| $R_{34}$ | 1MΩ pot. log track (volume) |
| $R_{35}$ | 1kΩ |
| $R_{36}$ | 100kΩ |
| $R_{37}$ | 1.5kΩ 5 watts |
| $R_{38}$ | 470Ω |
| $R_{39}$ | 220kΩ |

(Note: The specified 5% tolerance resistors were chosen by virtue of their small physical size but 10%, and, in some cases 20%, components could be utilised. Standard tubular capacitors could also be incorporated if the Mullard polyester types are not required).

*Valves*

| | |
|---|---|
| $V_1$ | EF183 Mullard |
| $V_2$ | ECH81 Mullard |
| $V_3$ | EF183 Mullard |
| $V_4$ | ECC82 Mullard |
| $V_5$ | ECH81 Mullard |
| $V_6$ | ECL83 Mullard |
| $V_7$ | EZ81 Mullard |

*Valveholders*

McMurdo B9A (7 off)

*Capacitors*

| | |
|---|---|
| $C_1$ | 25pF variable (Jackson Bros. type C.804) |
| $C_{2(a),(b),(c)}$ | 315pF variable, 3-gang, (Denco Ltd.) |
| $C_3$ | 3-30pF concentric trimmer |
| $C_4$ | 0.01μF tubular (Mullard) |
| $C_5$ | 100pF ceramic |
| $C_6$ | 0.01μF tubular (Mullard) |
| $C_7$ | 0.1μF tubular (Mullard) |
| $C_8$ | 0.01μF tubular (Mullard) |
| $C_9$ | 3-30pF concentric trimmer |
| $C_{10}$ | 0.01μF tubular (Mullard) |
| $C_{11}$ | 100pF silvered mica |
| $C_{12}$ | 100pF silvered mica |
| $C_{13}$ | 0.1μF (Mullard) |
| $C_{14}$ | 0.01μF tubular (Mullard) |
| $C_{15}$ | 3-30pF concentric trimmer |
| $C_{16}$ | 0.01μF tubular (Mullard) |
| $C_{17}$ | 0.01μF tubular (Mullard) |
| $C_{18}$ | 0.5μF tubular (Mullard) |
| $C_{19}$ | 0.1μF tubular (Mullard) |
| $C_{20}$ | 0.1μF tubular (Mullard) |
| $C_{21}$ | 0.1μF tubular (Mullard) |
| $C_{22}$ | 120pF silvered mica |
| $C_{23}$ | 0.01μF tubular (Mullard) |
| $C_{24}$ | 330pF silvered mica |
| $C_{25}$ | 0.5μF tubular (Mullard) |
| $C_{26}$ | 20pF silvered mica |
| $C_{27}$ | 0.01μF tubular (Mullard) |
| $C_{28}$ | 0.001μF ceramic |
| $C_{29}$ | 0.05μF tubular (Mullard) |
| $C_{30}$ | 100pF ceramic |
| $C_{31}$ | 160pF silvered mica |
| $C_{32}$ | 1,500pF silvered mica |
| $C_{33}$ | 100pF ceramic |
| $C_{34}$ | 25pF variable (Jackson Bros. type C.804) |
| $C_{35}$ | 0.01μF tubular (Mullard) |
| $C_{36}$ | 25μF, 12V wkg, electrolytic |
| $C_{37}$ | 270pF silvered mica |
| $C_{38}$ | 270pF silvered mica |
| $C_{39}$ | 0.005μF tubular (Mullard) |
| $C_{40}$ | 10μF, 12V wkg, electrolytic |
| $C_{41}$ | 25μF, 25V wkg. electrolytic |
| $C_{42}$ | 0.1μF tubular (Mullard) |
| $C_{43}$ | 0.01μF tubular (Mullard) |
| $C_{44}$ | 0.1μF tubular (Mullard) |
| $C_{45}$ | 0.1μF tubular (Mullard) |
| $C_{46}$ | 32μF, 450V wkg, electrolytic |
| $C_{47}$ | 16μF, 450V wkg, electrolytic |
| $C_{48}$ | 5,000pF ceramic |
| $C_{49}$ | 5,000pF ceramic |

*Flexible Coupler*

Miniature ceramic type (H. L. Smith & Co., Ltd.)

*Chassis, Panel, Cabinet*

H. L. Smith & Co., Ltd.

*Coil Turret*
Type CT7/B (Denco Ltd.)
$IFT_{1,2}$ 465kc/s type IFT11/465 (Denco Ltd.)

*Switches*
$S_{2(a)}$, (b), (c), (d), 4-bank, 4-pole, 3-way type S15 (Denco Ltd.)
$S_3$ d.p.s.t. type S300 (A. F. Bulgin)

*BFO Coil*
465kc/s type 465/BF02 (Denco Ltd.)

*Output Transformer*
$T_1$ type 117E (H. L. Smith & Co., Ltd.)

*L. F. Choke*
$T_2$ 10H, 120mA, 200 Ω, type M101 (H. L. Smith & Co., Ltd.)

*Mains Transformer*
Pri: 0-200-220-240; Secs: 250-0-250V, 120mA; 6.3V (centre-tapped) 4A; 6.3V, 1A. Type 7023, (H. L. Smith & Co., Ltd.)

*Phone Jack and Socket*
Igranic (H. L. Smith & Co., Ltd.)

*Dial Lamps & Mountings*
6.3V, 0.3A (H. L. Smith & Co., Ltd.)

*Fuse and Holder*
Cartridge type with 1A fuse (H. L. Smith & Co., Ltd.)

*Speaker*
7 × 4 in. elliptical 3 Ω

*Leadthroughs*
As required (see text) (H. L. Smith & Co., Ltd.)

*Knobs*
H. L. Smith & Co., Ltd.

*Dial, Drive Mechanism etc.*
Eddystone Cat. No. 898 (Home Radio Ltd.)

*Tagstrips*
5-way (as shown in Fig. 7)
4-way (both end tags earthed)

in the writer's opinion, a 100kc/s crystal oscillator. With the aid of this device, the operator is able to calibrate the receiver accurately on each 100kc/s point over the frequency range merely by switching on the h.t. supply to the oscillator. Ideally, such an addition should be so made that the stage is placed physically near the r.f. stage, the output of the oscillator being fed via a small capacitive or inductive coupling into the aerial input circuit. Constructors will note that the additional chassis space required for such an inclusion has been deliberately made available in the present design (chassis G in Fig. 4). There are many r.f. pentodes which would perform well in an oscillatory circuit using a 100kc/s crystal, the current radio press often featuring such designs. An EF80 would be an ideal choice for such an application, thus conforming to the B9A Noval base range used throughout the receiver.

Lastly, an additional refinement could be a voltage stabiliser mounted near, and supplying h.t. potential to, the mixer/oscillator valve. The Mullard 150C2 stabiliser could be chosen for this task, the stabilised voltage being supplied direct to the oscillator triode anode circuit.

The added circuits mentioned in the foregoing paragraphs may be culled from the current radio press. *The Radio Constructor* (published monthly on the first of each month) often features suitable designs either as separate units or included as an integral part in other designs. The intending constructor of this receiver will by now be aware, from the foregoing, that having once embarked on the basic 5 or 7 valve design, much enjoyable constructional work may be carried out over a period of time—each addition considerably adding to the overall efficiency of the receiver.

## Circuit

The circuit of the receiver is shown in Fig. 1 and it will be seen that this comprises the complete 7-valve design. As mentioned earlier, those requiring *in the first instance* the 5-valve design only will have to omit both the r.f. ($V_1$) and the product detector ($V_5$). In the writer's opinion, the best method to adopt in this case is for the constructor of the 5-valve version to include *from the outset* the valveholders for the other two valves. Valveholders are inexpensive items and, once these are included, it will be a comparatively easy matter to wire the two stages into the circuit at a later date. The alternative of course is that, once the 5-valve design is completed, two chassis sub-assemblies have to be removed in order to accomodate the two added valveholders, with all the consequent disconnections that this process will entail. Moreover, should the constructor be wise enough to add the valveholders of both $V_1$ and $V_5$ at the outset, it will be a much easier proposition to include *all* the 6.3V heater wiring and *all* the connections to the switch $S_{2(a)}$, (b), (c), (d) from the start. The product detector stage, itself, is simply omitted altogether, whereupon the

switch $S_{2(a)}$, (b), (c), (d) retains its function as a Standby/Receive control on positions 1 and 2.

**7-Valve Design**

The signal is fed, via a length of coaxial cable, the outer braiding of which is earthed, to connection C of the turret (see Fig. 2).

The signal induced across $L_1L_2$ is tuned by one section of the three-gang variable capacitor $C_{2(a)}$ and the additional capacitances given by $C_1$ (the r.f. trim control) and $C_3$. Automatic gain control is applied to the grid of $V_1$ (EF183) via $R_3$ from the main a.g.c. line. $R_2$ and $C_6$, together with the r.f. gain control $R_4$, provide cathode bias for this stage, variation of $R_4$ taking the stage up to, and just short of, the oscillation point. $R_1$ and $C_4$ are the screen grid decoupling components whilst the anode is connected, via a short length of coaxial cable, to tag K of the turret. $C_7$ decouples winding ($L_3$) to chassis, and the required h.t. potential is applied to tag J via $R_5$.

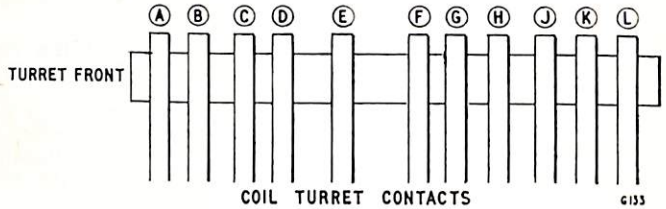



*Fig. 2. The coil turret contacts.*

It should be noted that for purposes of clarity, only one set of coils is shown in the circuit diagram. The purpose of switches $S_{1(a)}$, (b), (c), (d), (e), (f) associated with $V_1$ and $V_2$ is that of bandswitching, and these switches are all contained, as an integral part, in the turret itself as supplied. (See Fig. 2).

The amplified and tuned r.f. signal is now applied, via the tuned winding $L_4$, to the grid of the mixer section of $V_2$ (ECH81), $L_4$ being tuned by a further section of the three ganged variable capacitor $C_{2(b)}$ and the associated trimmer $C_9$. The values of the various resistors shown in the h.t. supplies to this valve have been carefully chosen in order that this stage should be operating under conditions which lead to excellent conversion without squegging.

The inclusion of both $R_8$ and $R_9$, with the associated decoupling capacitor $C_{14}$, ensures that the oscillator triode anode receives a voltage of 90, this being somewhat less than that normally encountered. The writer prefers a low voltage at this point in the interests of oscillator stability. $C_{10}$ and $R_{11}$ are the cathode bias components, $R_{10}$ being the oscillator grid leak. Both $C_{11}$ and $C_{12}$ are silver-mica capacitors, thus assisting in maintaining oscillator stability. $L_5$ is the oscillator grid winding and this is tuned by the remaining section of the three ganged capacitor, $C_{2(c)}$, with the trimmer $C_{15}$ in parallel. The capacitor marked P is a padding component included in the coil turret as supplied and is fitted on one range only. The oscillator feedback winding is represented by $L_6$.

The resultant i.f. signal appears across $IFT_1$ and is fed direct to the grid of the i.f. stage $V_3$ (EF183). The fixed capacitors shown connected across both $IFT_1$ and $IFT_2$ windings are integral parts of these components as supplied.

The numbers shown around all the valves in Fig 1 represent the valve pin numbers as viewed from the underside of the valveholder. Similarly, those shown around the i.f. transformers are the pin numbers for the specified components. A.G.C. is applied to the i.f. stage by way of $R_{13}$ and $C_{16}$. Cathode bias is applied to $V_3$ via the components $C_{17}R_{16}$ and the potentiometer $R_{17}$, the latter being the i.f. gain control. $R_{15}$ decouples the i.f. transformer from the applied h.t. potential whilst $R_{14}$ and $C_{19}$ supply the screen grid with the required voltage and decoupling. The amplified i.f. signal appearing across $IFT_2$ is next applied to the wiper contact of the switch $S_{2(a)}$.

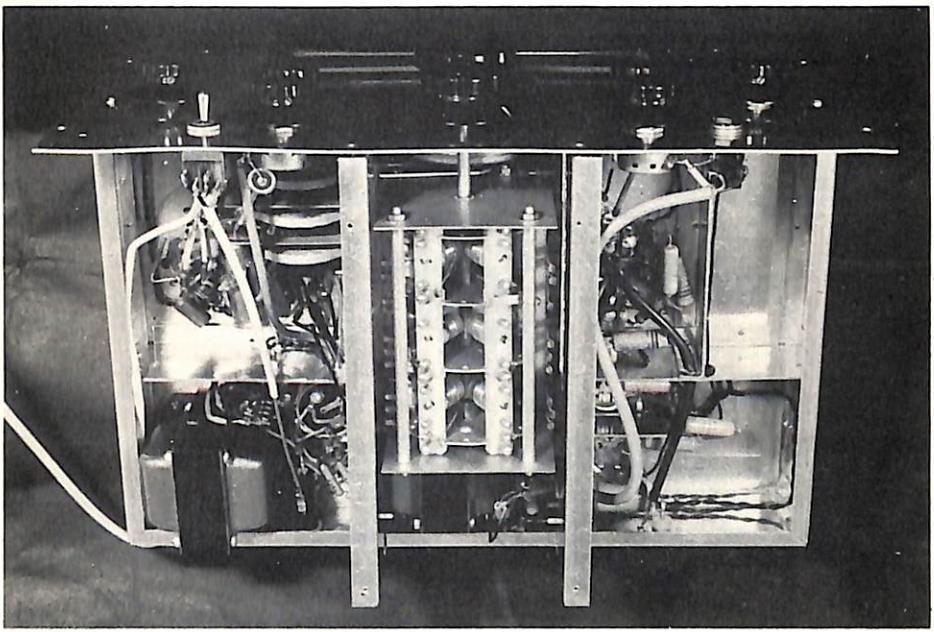
The wiper contact of this switch is connected direct, via $C_{22}$, to both the anode and the grid of the first half of $V_4$ (ECC82). This half of the double triode valve is diode-connected (i.e. the grid is strapped to the anode and, therefore, we are left with, in effect, a cathode and an anode). At all positions of $S_{2(a)}$, $C_{22}$ is connected to $V_{4(a)}$, this diode providing rectified a.g.c. voltage (negative) via $R_{19}$ to the main a.g.c. line. The time constant of the a.g.c. system is arranged for a slow decay thus enabling satisfactory reception of both s.s.b. and c.w. (morse) signals without the inclusion of an a.g.c. on/off switch.

The circuit, as shown, provides for both carrier and product detection dependent upon the position of $S_{2(a)}$, (b), (c), (d). This switch has been so wired that it acts, in

position 1, as a standby switch. In this position, no output from the last i.f. transformer is provided for $V_{4(b)}$ (the a.m. detector) and no h.t. voltage is applied either to this stage or to the product detector $V_5$. Additionally, no input is provided from the detector to the grid of the output stage. In this position, then, switch $S_2$ as a whole effectively cuts the h.t. potential to the detector, the product detector, and the signal inputs to the respective grids of both $V_{4(b)}$ and $V_{6(a)}$. The receiver is, in consequence, effectively muted with respect to signals, whilst the valve heaters are still supplied with an a.c. voltage in order that these stages shall be ready for immediate operation when required.*

manner, it will be noted that the a.g.c. voltage from $V_{4(a)}$ is still operative whilst the detector portion of this valve is inoperative.

The combined product detector and b.f.o. are contained within a single envelope ($V_5$) and this, in the writer's opinion, is a great advantage over the more normal method of utilising a separate b.f.o. valve and a double-triode as the product detector. A further advantage here is that the Colpitts oscillator circuit does not require a tapped coil—such a component being rather difficult to obtain ready made. The values of the capacitors $C_{31}$ and $C_{32}$ have been so calculated that the tap (in effect the earthed point between the two capacitors) is roughly 10% of the total tuning capacitance. The total capacitance



*Below-chassis view showing, at left, the l.f. choke $T_2$ and 5-way tagstrip mounted under chassis A; centre, the coil turret and output transformer $T_1$; right, the r.f. and i.f. stages.*

In position 3, $S_{2(a)}$ takes the output from $IFT_2$ and applies this to the grid of the product detector $V_5$ (ECH81) via a 20pF capacitor $C_{26}$, the grid being taken to chassis via $R_{29}$. At $S_{2(b)}$ the output from the product detector, via $C_{29}$, is taken to the grid of the first audio stage ($V_{6(a)}$). At $S_{2(c)}$ h.t. is disconnected from the a.m. detector ($V_{4(b)}$) and, at $S_{2(d)}$, h.t. is applied to the product detector and its oscillator. In this

in parallel across the winding ($C_{31,32,34}$) is such that the specified coil (only one winding of which is used) will oscillate at 465kc/s, plus or minus the required variation given by the iron dust core and the variable capacitor $C_{34}$ (b.f.o. pitch control).

In position 2, the switch (at $S_{2(a)}$) applies the output from $IFT_2$ to the grid of $V_{4(b)}$, whereupon the latter stage operates as an infinite impedance detector. The great

*When used with an amateur transmitter, it may be preferable for $S_{2(c)}$ to break the h.t. supply to $V_1$, $V_2$, and $V_3$ as well as $V_{4(b)}$.

advantage of this type of detector is that it has very little effect on the secondary of the last i.f. secondary winding. At $S_{2(b)}$ the a.f. output from the detector cathode is fed through the r.f. decoupling components $C_{37}R_{33}C_{38}$ and via $C_{39}$ to the volume control ($R_{34}$) and, thence, to the grid of $V_{6(a)}$. At $S_{2(c)}$ h.t. is applied to the a.m. detector, $V_{4(a)}$. At $S_{2(d)}$ no h.t. potential is applied to the product detector.

Output into the headphone socket is via $C_{44}$, insertion of the jack into this socket automatically muting the speaker.

The power supply stage is conventional and conforms to standard practice with reference to present day communication receiver design. Isolation from the a.c. mains supply is obtained by the inclusion of the mains transformer $T_3$. Adequate smoothing and ripple-free h.t. potential is

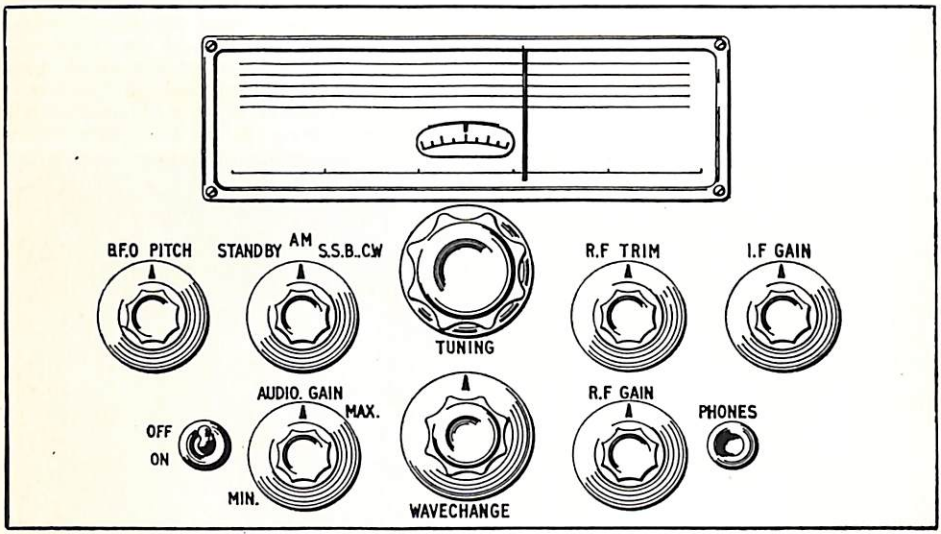



*Fig. 3. Diagram showing the layout of the front panel.*

When in use, oscillations deriving from the b.f.o. circuit (triode portion of the valve) are fed, via $C_{30}$, from the oscillator anode to the product detector section of the valve, thus enabling s.s.b. (single side band) signals to become intelligible after variation of the pitch control $C_{34}$. This also enables c.w. signals to be received.

It will be noticed that both the outputs from $V_{4(b)}$ (a.m. detector) and $V_{5(a)}$ (product detector) are fed through the r.f. filter network (via $S_{2(b)}$) to the volume control. A fixed bias derived from the h.t. line is applied to the cathode of $V_{4(a)}$ via $R_{18}$ to prevent operation of the a.g.c. circuit when receiving weak signals.

In order to prevent instability and induced hum, the connection from the slider of the volume control $R_{34}$ to the grid of the first audio stage ($V_{6(a)}$) is screened. The triode section of this stage is a normal a.f. voltage amplifier which is resistance-capacitance coupled to the pentode control grid. The resultant audio output from the pentode appears across the output transformer $T_1$ and is then applied to the speaker.

obtained from the smoothing circuit given by $C_{46}C_{47}$ and the l.f. choke $T_2$.

It will be noted that the rectifier $V_7$ (EZ81) has its own heater winding and that the remainder of the valves in the circuit are fed from a further winding which is adequately rated to supply the required current. All heater leads are composed of a twisted pair of wires and an earthed heater return is not recommended. The two ceramic capacitors $C_{48}$ and $C_{49}$ prevent the appearance of r.f. voltages on the heater wiring.

The double-pole-single-throw switch $S_3$ (on/off) ensures that the mains a.c. supply is completely disconnected when in the off position. A 1A fuse is inserted in the live mains lead as an overload protection device.

### The 5-Valve Circuit

As mentioned in the introduction, the two valves to be omitted for the 5-valve circuit are the r.f. stage and the product detector/b.f.o., ($V_1$ and $V_5$). If either of these stages are to be included at a later date, the earlier remarks with reference to inclusion of the valveholders from the outset are again

brought to the reader's attention. Most probably many constructors who are primarily interested in a.m. transmissions only (both broadcast and amateur) will include the r.f. stage after having successfully completed the standard 5-valve circuit, especially since the coils will be already available on the turret.

For those who require to include the r.f. stage at a later date, the aerial connection

the time being, and may be employed later for the oscillator calibrator or Q multiplier stages.

The illustrations show clearly the above-chassis, below-chassis and rear view of the completed receiver.

Figs. 5 and 6 are included here for those who prefer to carry out their own chassis work.

As received, the cabinet, panel and chassis

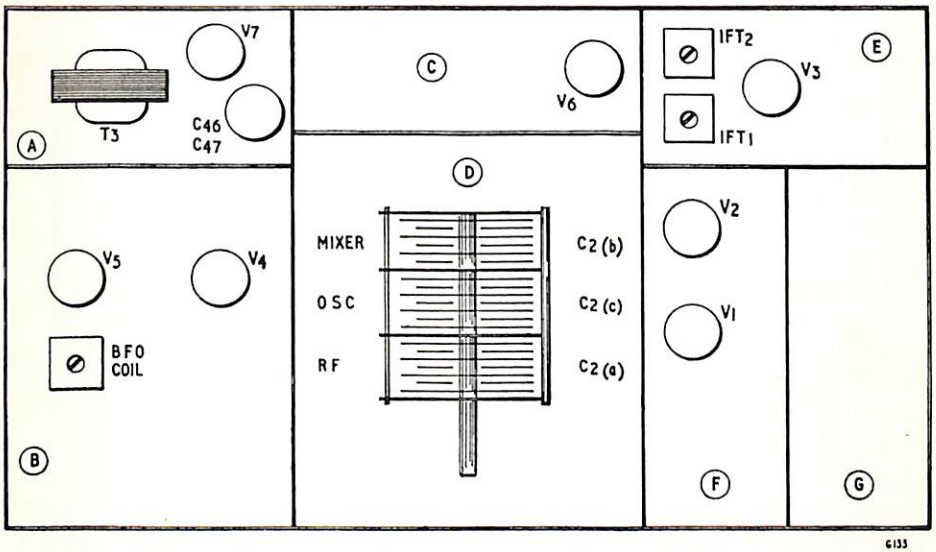



*Fig. 4. Plan diagram of the chassis deck. In this "free deck" chassis (A) is for the power supply stage; (B) the a.m. detector/a.g.c. and product detector/b.f.o. stages; (C) the a.f and output stages; (D) the coil turret; (E) the i.f. stages; (F) the r.f. and frequency charger stages; and (G) a spare for later additions.*

should be made direct to point K, omitting the h.t. connection altogether and also, of course, $R_5$. Point J should be taken direct to chassis, omitting $C_7$.

To omit the circuit of $V_5$, it is simply a question of omitting all the wiring and components associated with this valve.

**Construction**

A study of the illustrations herewith, together with the diagrams of Figs. 3 and 4, will clearly show the general plan of layout, wiring and the positions of the main components. Fig. 3 shows the positions of the controls on the front panel and it will be noted here that sufficient room has been left for the additions of any further controls the individual operator may wish to add.

Fig. 4 shows the general layout above the chassis and it will be noted that each individual chassis of the free-deck system has been allocated a letter. Thus A is for the power supply, B the detector/a.g.c. and product detector/b.f.o. stages, C the output stage, D the coil turret and main tuning capacitor, E the i.f. stage and F the r.f. and mixer/oscillator stages. G is left blank for

are bolted and screwed together, and must be partly disassembled in order to fit the turret into the space allocated. A close inspection of the illustrations will make clear most of the assembly prior to wiring-up the receiver.

The majority of the feedthrough connections from one stage to another (i.e. heater wiring, h.t. wiring, the a.g.c. line, interstage connections, etc.) are taken through the interstage screens via small polythene leadthrough components. These consist of an inner continuous wire surrounded by the necessary polythene insulator—the latter being force fitted into holes drilled through the screens. Alternatively, of course, small rubber or p.v.c. grommets could be utilised throughout.

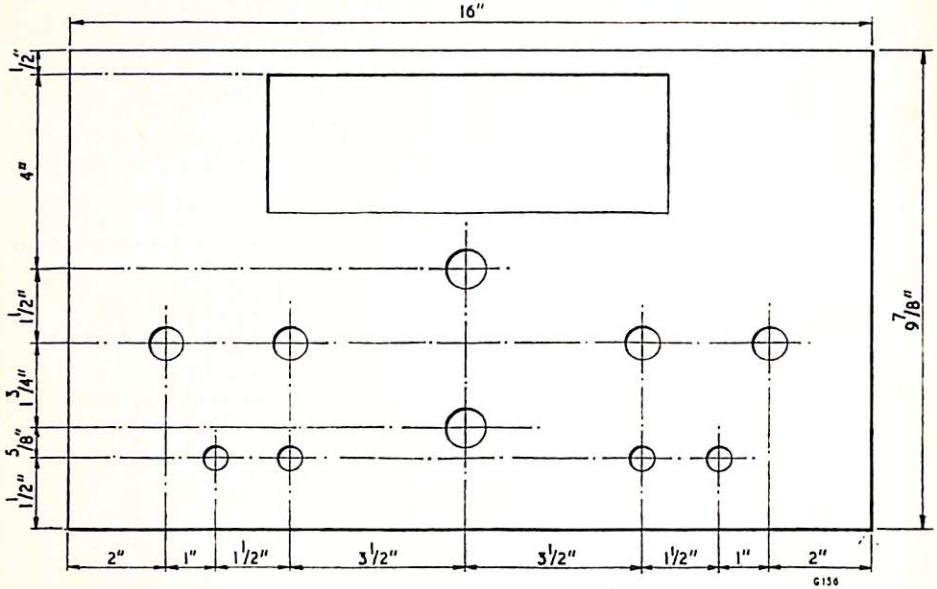



*Fig. 5. Front panel drilling dimensions. A template is provided with the dial.*

Grommets have been used in the prototype for the more bulky interstage connections such as the aerial input, volume control and phone socket wiring.

For those who obtain the cabinet etc., ready drilled (see Components List) assembly will merely be a matter of following the diagrams and illustrations. For those who prefer to "roll their own", some planning is required to make certain that all interstage screens have been drilled with their respective leadthrough holes before assembly of the chassis parts.

All connections from the turret are brought through the turret screening by means of the polythene leadthroughs, these being soldered at one end direct to the turret tags and, at the other end, to the various components and wiring.

Chassis D should be fitted, before assembly to the main chassis frame, with the turret on the underside and the 3-gang variable capacitor on the upper side, the latter being spaced away from the chassis deck by metal tubular spacers (two to each "leg") through each of which is fitted the long 2BA bolts. This is necessary in order that the spindle of the capacitor will, when finally fitted with the flexible coupler, accurately mate with the spindle of the dial drive mechanism. The three small holes drilled through chassis D should now be fitted with small rubber grommets through which the leads from the capacitor are taken to their respective connections. These are: front section of the capacitor (r.f. stage) to tag B of the turret; centre section (oscillator) to tag E of the turret; and rear section (mixer grid) to tag H of the turret. The remainder of the turret connections must be made with the side member (screen) shown between the turret and the r.f. and mixer/oscillator stages temporarily bolted to chassis D. All this work must, of course, be carried out *before* the chassis is secured finally to the chassis frame itself. Once the wiring of this sub-assembly is completed, it can be permanently bolted to the chassis frame.

The front panel should now be fitted with the lower line of controls as shown in Fig. 3, these being the on/off switch, the audio gain potentiometer, the r.f. gain potentiometer and the phones socket. Follow this by mounting into position the dial drive mechanism and escutcheon. The wavechange switch spindle will, of course, automatically fit through the hole indicated.

Secure the front panel to the main chassis frame, fitting the flexible coupler to the variable capacitor spindle and carefully guiding this on to the dial drive mechanism spindle. The remainder of the front panel controls may now be fitted to the panel via the front chassis member.

The next stage to deal with is the power supply and the first job here is to secure into position the l.f. choke followed by the mains transformer—note from the illustrations the

correct positioning of these two components —the mains transformer being that mounted above the chassis deck. Secure into position the valveholder (fitting an earth tag under one of its securing nuts), the smoothing capacitors ($C_{45}$ and $C_{46}$ are contained within a single metal container) and the 5-way tagstrip. (See following paragraph for details). This sub-assembly can then be wired up, as far as possible, prior to securing to the chassis frame. The fuse is mounted through the rear member of the chassis frame and the mains lead is fed through the large rubber grommet fitted to the same member.

It should be noted that the electrolytic capacitors $C_{46}$ and $C_{47}$ (in their single metal casing) are secured, by means of a clip mounted on the *underside* of the chassis. It will be from the illustration that the metal casing of $C_{45,46}$ protrudes through the chassis deck for about half of its total length. To the bolt securing the clip to the metal casing of this component is also fitted the 5-way tagstrip, this being mounted vertically by the simple expedient of bending the mounting earthed tag so that it becomes straight and not, as supplied, at an angle of 45°. To this tagstrip (see Fig 7) is soldered

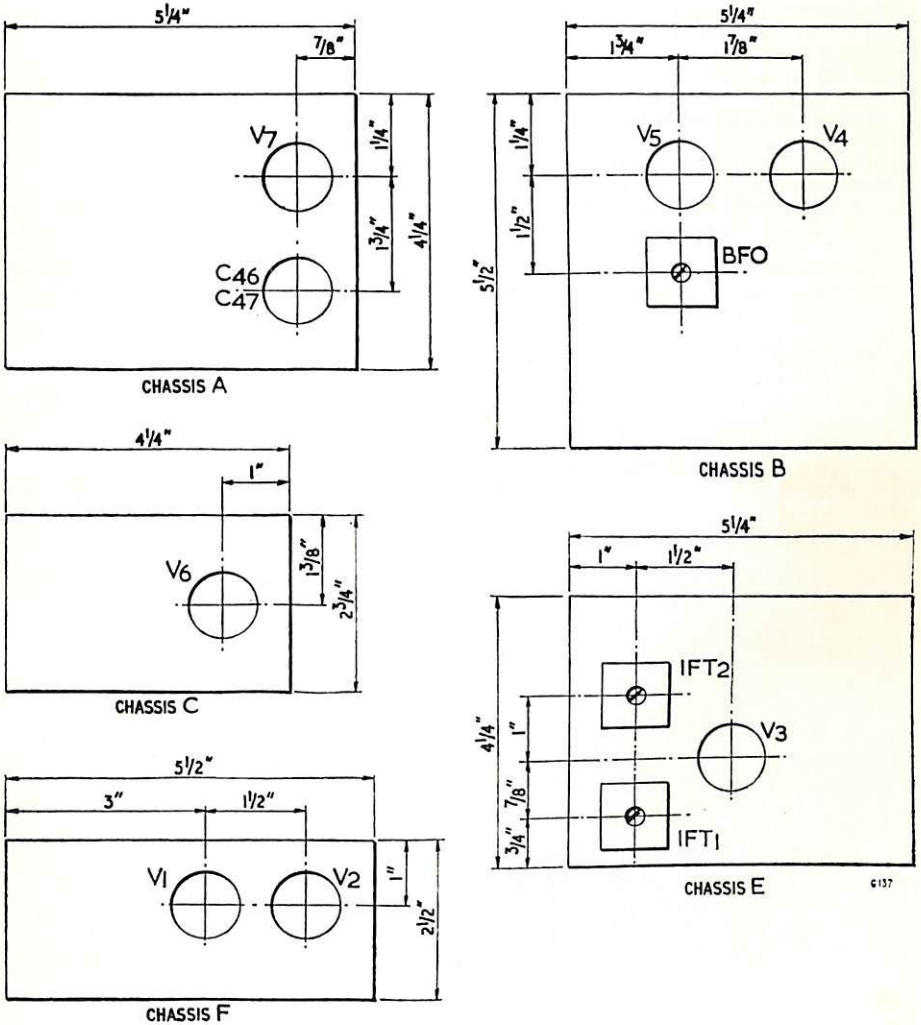
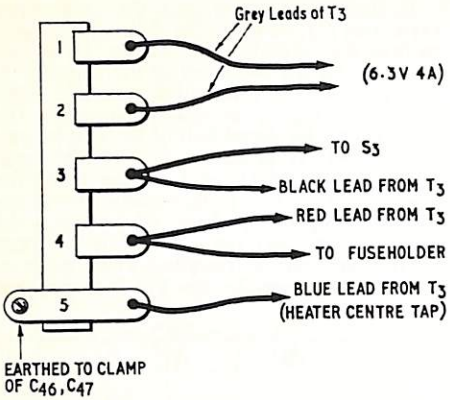



*Fig. 6. Drilling dimensions of the various sub-assembly chassis.*




CONNECTIONS TO 5-WAY TAG STRIP

G138

*Fig. 7. Connections to the 5-way tag-strip secured under chassis A to the metal clamp of $C_{45}$ and $C_{46}$. Note that the 240 volt $T_3$ primary tap connects to tag 4. For lower mains voltages, employ the appropriately coloured lead indicated in Fig. 1.*

the various leads emanating from the mains transformer (except those connected to $V_7$ anodes and heater). The switch $S_3$ and fuseholder connections are shown in Fig 8.

**Valveholders**

All the remaining valveholders may now be mounted to their respective chassis, and with each valveholder an earth tag is secured under one of the nuts. The orientation of the valveholders will be evident if it is remembered that all anode and grid leads should be kept as short as possible. Across each valveholder (except of course, $V_7$, which is already fitted) should now be soldered a small piece of tin plate cut to the dimensions shown in Fig. 9. The writer found a prolific supply of this tinplate from an empty cocoa tin, which was first cut along its length with a pair of tinsnips, severed from the bottom of the tin, opened out and finally cleaned with some rag and a little petrol or lighter fuel. Care should be taken to avoid cutting the fingers; the tin is very sharp at the edges and an unfortunate slip could prove disastrous.

When dealing with $V_1$ and $V_3$, the small screen should be soldered across the valveholder such that it is connected at the centre to the central metal spigot, to pin 6 and to the earth tag that has previously been bolted into position with the valveholder. Note that the screen *should not* connect with any other pins of the valve.

With $V_2$ and $V_5$, the screen should extend across the valveholder such that pins 7, 8 and 9 are shielded from the remainder of the pins. Here, with these two valves, the screen should be soldered to the central metal spigot and the earth tag *only*.

$V_4$ screen should be soldered into position such that pins 1, 2 and 3 are shielded from the remainder and that it is connected to the spigot and the earth tag *only*.

The screen for $V_6$ should be soldered so that pins 1, 2 and 3 are shielded from the other pins, the spigot and earth tag *only* being connected.

It is important to note here, before proceeding further, that most of the earth returns (i.e. components connected at one end direct to the chassis as shown in Fig. 1)

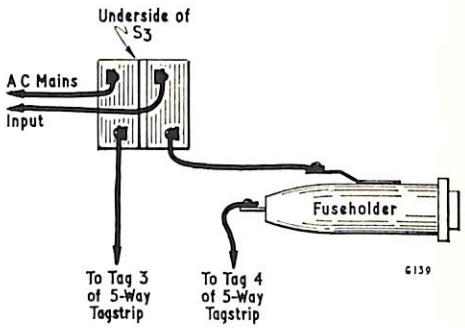



*Fig. 8. Wiring details of the mains on/off switch $S_3$ and the fuseholder.*

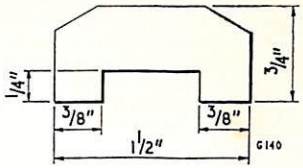


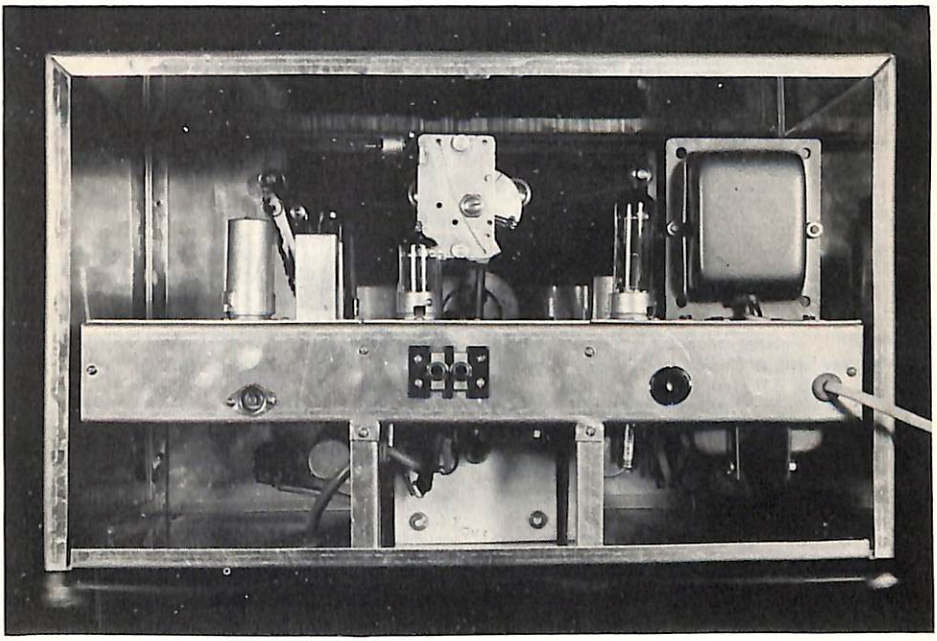

*Fig. 9. Measurements of the valveholder screens.*

are made to these valveholder screens. This applies in particular to both the r.f. and mixer/oscillator stages, but it also applies, in the main, to the other stages as well. Since all stages are wired up whilst removed from the chassis and when in sub-assembly form, this becomes quite an easy matter. In this manner, earth returns are kept as short as possible and, what is more important, the chassis connections for any one stage are made at only one point (i.e. the earth tag connected to the valveholder screen). This obviates circulating currents in the chassis and considerably assists with respect to the overall stability and ultimate performance of the completed design. Additionally of course, interaction and undesirable couplings between the various anodes and grids are eliminated. The use of these valveholder screens, together with the actual interstage screens incorporated in the chassis itself, all contribute towards producing a *reliable* communications receiver, their effects being cumulative in avoiding instability.

The two i.f. transformers should now be fitted to chassis E, care being taken to ensure that they are mounted in such a manner that the associated wiring to them is kept as short as possible. The pin numbers of these transformers are shown in Fig. 1 and the actual numbers are visible on the underside of the components themselves. It is a good idea here for the constructor to ascertain these pin numbers and to mark the metal container accordingly with a pencil prior to mounting the transformers on the chassis.

The b.f.o. coil may now be mounted to chassis B, ensuring that pins 1 and 3 are nearest the $V_5$ valveholder, and marking the can as just described prior to mounting on the chassis.

The output stage should now have the output transformer ($T_1$) mounted to its chassis (C), noting that this component is fitted below the chassis.

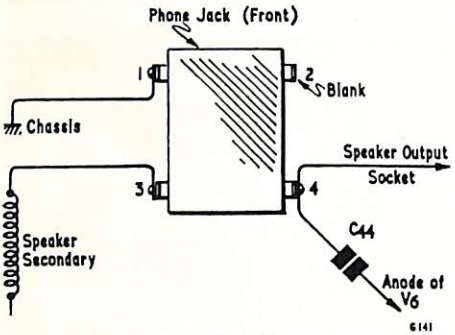


*Rear view of the receiver within the cabinet. Note how the coil turret is completely screened from the remainder of the wiring. On the rear of the chassis, at left, is the aerial input; centre, speaker output and right, fuseholder and mains input.*

This completes the assembly of the main components and all that is left are the 4-way tagstrip to be mounted under chassis F; the additional interstage screen between $IFT_1$ and $IFT_2$; the speaker output sockets at the rear of the chassis and the various polythene feedthrough fitments in the interstage chassis screens.

### Wiring Up Notes

Commence with $V_1$ and $V_2$ stages (having already completed the power stage of $V_7$). With the sub-assembly of chassis F removed from the main chassis frame it will be found an easy matter to solder into circuit the associated components, keeping their respective wire ends, or lead-out wires, as short and as direct as possible. When dealing with $V_1$, $C_4$ is soldered (with shortened wire ends) direct from pin 8 to the valveholder metal screen already fitted. However, before actually soldering the connection at pin 8, cover *both uncut* wire ends of $R_1$ with sleeving and place one wire end at pin 8; then solder both $R_1$ and $C_4$ to pin 8. The wire ends of $R_1$ are left uncut for the reason that this component must carry h.t. from the 4-way tagstrip* to pin 8 and therefore the full lead length is necessary for this to occur.




The above example, if not immediately understood, should be read carefully again by the intending constructor who is not overfamiliar with constructional practices. A little forethought will pay large dividends in the long run and save endless time and trouble with the construction of this receiver. It will be found that such forethought will be required again and again whilst the wiring process is being carried out.

It will be noted from the illustrations that many of the components associated with the valveholders are wired from the valve pins to the earthed screen and that such components are mounted almost vertically.

The aerial input lead employs coaxial cable, the outer metal braiding of which should be earthed to chassis at both ends. This also applies to the coaxial cable connecting the anode of $V_1$ to the turret connection K. These remarks apply again to the lead (shown in Fig. 1) from pin 3 of $IFT_2$ to the wiper arm of $S_{2(a)}$, and that from $R_{34}$ (the volume control) to pin 2 of $V_6$. Note also that screened cable is used for the connections to the phone socket.

Having wired up most of the $V_1$ and $V_2$ circuits, chassis F should be secured to the main frame and the remainder of the connections, as far as possible, completed. It should be noted that pins 1 and 3 of $V_1$ should be connected together.

$V_3$ and associated components, together with both $IFT_1$ and $IFT_2$, should now be dealt with. Note that (as in the circuit of $V_1$) pin 6 should be earthed to the valveholder screen and that pin 9 *must be externally connected* to pin 1 and 3. The latter two pins should be connected together.

When the wiring of $V_3$ is as near to completion as possible outside the main chassis, it should be secured to the main frame and the remainder of the connections made.

A check should be made now that all heater wiring (twisted pair) is placed well away from the tuned circuit wiring (anode and grid leads) and is tucked neatly alongside the interstage chassis screens and *as close to the underside of the various chassis as possible.* This will considerably assist in preventing induced 50 c/s mains hum becoming prevalent in the completed design.

*Fig. 10. Wiring details of the headphone jack (socket). Note that one tag is left blank.*

Whilst dealing with the subject of heater wiring, it should be mentioned that $V_4$ (ECC82) has a centre-tapped heater. Here, one heater supply lead should be joined to *both* pins 4 and 5, the remaining heater lead being connected to pin 9.

Chassis B containing $V_4$ and $V_5$ should be dealt with next. Here the constructor must deal with the specified switch (assuming of course that this is being incorporated in the design chosen by the builder). It is a good plan to remember that the switch positions, as marked on the front panel, will be (1) Standby; (2) A.M. and (3) S.S.B., in a clockwise direction. For ease of construction, remove the switch from the front panel and make the h.t. switching circuit from $S_{2(c)}$ to

*The 4-way tagstrip should be mounted beneath the chassis alongside both $V_1$ and $V_2$, this tagstrip being utilised for the h.t. + supplies, via the various resistors, to the appropriate points of the circuits of both these valves.

$S_{2(d)}$ whilst the switch is outside the chassis. If in doubt with respect to the various positions, fit a knob to the spindle and turn the switch clockwise, or as required, until the action and tag numbers are thoroughly understood—frequent reference to Fig. 1 assisting here. It is also an excellent plan to use various coloured connecting wires and note the colours on a sheet of notepaper in order to avoid wiring errors. Those having a meter, or even a simple continuity tester such as a buzzer or bell, will very soon be able to ascertain the tags corresponding to the switch connections, wiper arm, etc. Wire the switch as far as possible, where necessary leaving p.v.c. covered leads (having noted the colours adopted) hanging free at the end furthest from the switch and secure the switch to the front panel. Complete the switch wiring.

The output stage is the next task to perform. Here it will be noted from the illustrations that some of the components are mounted vertically, these being $R_{36}$, $R_{37}$ and $C_{44}$. These should have their wire lead-outs suitably covered with sleeving. It will be found that the output stage is somewhat compact and the h.t. connections of $R_{36}$, $R_{37}$, and the phone socket connection of $C_{44}$ (See Fig. 10) have to be made after the sub-assembly is secured to the main frame of the chassis.

The speaker connections from the secondary of the output transformer $T_1$ will similarly have to be made to the output socket once chassis C is secured into position. See Fig. 10 for phone socket connections.

After the wiring of the receiver is complete, a check should be made to ensure that all connections are correct and that no short-circuits to chassis exist.

### Testing and Aligning

With the valves plugged in to their respective holders, the aerial and earth connected and the speaker in circuit, testing and alignment of the receiver may commence. In the prototype, the earth connection is made via the metal braiding of the aerial down lead, this being earthed externally to the receiver. The speaker is, of course, contained in a separate small cabinet and normally placed on top of the receiver cabinet when in use.

Place all gain controls to the midway position and switch $S_2$ to the a.m. position. Turn the wavechange switch to Band 2 (mid position) and switch on the on/off control. The valve heaters should light up and some sound (even if only a hissing noise) be heard in the speaker.

Adjustment of the tuning control should produce a variety of signals which may be varied in strength by the gain controls and $C_1$ (r.f. trim).

The i.f. cores should now be adjusted in order to produce the best response, and it should be remembered that each i.f. coil contains two cores, both of which must be adjusted. This process should be repeated several times until no further improvement is possible. If no signal generator is available, i.f. alignment should not be carried out whilst the receiver is tuned to a station, the reason being that short wave stations often suffer from signals which rise and fall in signal strength. It is best here to align the i.f.'s using the general "noise"—an increase being noted when the circuits are in tune.

Without a signal generator, r.f. alignment can be accomplished by using stations having a known frequency.

### Using a Signal Generator

With a signal generator and output meter the i.f. transformers should be aligned to 465kc/s, the output of the generator being sufficiently restricted to avoid operating the a.g.c. (in both i.f. and the following r.f. alignment).

With the signal generator connected to the grid of the frequency changer ($V_2$) set the coverage of range 3 (see Table) by adjusting the oscillator dust core at the low frequency end and the oscillator trimmer ($C_{15}$) at the high frequency end. Return to the low frequency end and readjust the core if necessary, returning to the high frequency end to re-align the trimmer. Continue with this process until the calibration is correct at both the frequencies shown in the Table.

**TABLE**

| | *Tracking Point 1* | *Tracking Point 2* |
|---|---|---|
| Range 1 | 1.65Mc/s | 4.05Mc/s |
| Range 2 | 4.4Mc/s | 10.8Mc/s |
| Range 3 | 11.0Mc/s | 27.0Mc/s |

Set to the low frequency end of each of the remaining two ranges by adjusting the appropriate oscillator core and check that the receiver calibration is correct.

Remove the signal generator from the grid of $V_2$ and inject into the grid of $V_1$.

Set the first tracking point on range 3 on the receiver and signal generator dials and peak by using the signal core. Set the second tracking point on the dials and peak by using the signal trimmer. Continue until no further improvements are possible. Seal the oscillator cores and signal trimmers after adjustment by using a little polystyrene dope.

Do not wait until the whole unit has been aligned as the cores and trimmers have a rather nasty habit of vibrating during the process of turret rotation.

For the remaining bands, peak the signal at the first tracking point with the iron dust core.

On range 2 variable 3-30pF trimmers are provided for peaking at the high frequency end. These will have to be slightly adjusted at the h.f. tracking point of 10.8Mc/s despite the fact that they have been previously adjusted at the factory. The trimmers are mounted adjacent to the range 2 coils on the rotor and should not be confused with the trimmers mounted on top of the 3-gang variable capacitor.

Proceed now to deal with the r.f. stage on the same lines as outlined above and at the same frequencies as for the signal circuits. The signal generator output will, in this case, be injected into the aerial socket by way of a dummy aerial.

**Using the Receiver**

Having had previous experience with other, simpler, designs, the operator will soon find that a superhet receiver provides much greater gain, selectivity and sensitivity over that given by "straight" or t.r.f. sets. Operation of the various controls is, of course, understood by their function in the circuit, i.e. the r.f. gain control obviously produces greater gain from the r.f. stage when rotated clockwise etc. The only control that may require some explanation in action is that of the b.f.o. pitch control when the receiver is set to the s.s.b. position.

When receiving the normal c.w. (Morse) transmissions, variation of the setting of the pitch control will effectively alter the pitch of the audible note. This can often be so adjusted that the signal required is made to "stand out" from any interfering signal or signals that may be present.

When receiving s.s.b. signals, the pitch control should be varied very slowly until the transmission becomes intelligible. The point at which this occurs is fairly critical but, with a little practice, the adjustment soon becomes an easy process to master.

The "Nightrider" receiver will be found to be extremely sensitive and selective, and many hours of enjoyable listening on the short wave bands have been spent with the prototype described here. The dial, as shown, is uncalibrated and this should be done with indian ink against known frequency points such as WWV or MSF (2.5, 5.0, 10.0Mc/s etc.,) together with other known transmissions. Alternatively, where a cystal calibrator is available, the 100kc/s or 1Mc/s points could easily be marked on the dial. For calibration, the dial covering glass has to be removed.

The wording shown on the front panel of the receiver is that obtained from Panel-Signs Set No: 4.


THE Radio Constructor

The *Practical* monthly magazine for the radio enthusiast. Articles cover Receivers, Televisors, Test Equipment, Aerials, Amplifiers, Intercoms, Recording Equipment, Radio Control of Models, Workshop Practice, Transistor Techniques, Understanding Radio, etc.
Available from your newsagent on the first of the month, price 2/6.
Individual copies available from the publishers, 2/6, plus 6d. postage.

# *Some Other Publications In The*
# DATA BOOKS SERIES

**DB6 The Radio Amateur Operator's Handbook**
64 pages. Price **5/–**, postage 6d.
Contains Amateur Prefixes, Radio Zone Boundaries, Amateur Band Frequency Allocations, Call Areas, Charts and Maps, Areas, Codes, Mileage Tables, Prefixes/Directional Bearings, Post Office Regulations, and much other useful operating data. For the beginner there are notes on how to use the mass of information given to obtain the greatest satisfaction from the hobby.
". . . this is an excellent five bob's worth!" *Mobile News.*

**DB15 Twenty Suggested Circuits**
48 pages. Price **3/6**, postage 4d.
By G. A. French. Covers subjects ranging from electronic laboratory equipment to the simplest of periodic switches. Includes: simple and inexpensive two-valve capacity bridge, short wave regenerative preselector, one-valve speech operated switching circuit, transformer ratio analyser, series noise limiter, receiver remote mains on-off control, and many other circuits.

**DB16 Radio Control for Models**
192 pages. Price **15/–**, postage 9d.
By F. C. Judd. Contains both theory and practical designs of simple and advanced transmitters and receivers; basic concepts, aerials, uses of radio components, transistorised receivers, multi-channel operation, etc. Sections on servo-mechanisms by Raymond F. Stock.
More than 200 illustrations. Circuits, photographs, tables and working diagrams.

**DB17 Understanding Television**
512 pages. Price **37/6**, postage 2/6
By J. R. Davies. This book, which deals with the principles of 625 line reception as fully as 405 line reception, fully explains: the nature of the television signal; the cathode ray tube; receiver tuner units; receiver i.f. amplifiers; a.f. and video amplifiers; vertical and horizontal timebases; deflector coil assemblies; synchronising; automatic gain and contrast control; power supplies and receiver aerials. Also includes a comprehensive introduction to colour television.
". . . one of the best books that aims to explain television in simple language . . .". R.S.G.B. Bulletin.

## FOR A REALLY PROFESSIONAL FINISH USE PANEL-SIGNS TRANSFERS

**Set 3 Wording—White.** Wording for Receivers, Amplifiers, Transmitters, Test Equipment and other Radio Apparatus. (Also 2 Safety Notices—white wording on red background) 6 sheets, over 1,000 words and symbols.
**Set 4 Wording—Black.** As in set 3. (Safety Notices have black wording on red background.)
**Set 5 Dials.** 6 sheets containing one Large and two Medium scales, Large Horizontal Tuning scale, Frequencies, 12 Control Panels (white markings, no background).
**Set 6 Dials.** As in set 5, but Control Panels have black background.
Price per set, **4/6**, postage 4d.

Smith's of EDGWARE ROAD

# BLANK CHASSIS

Precision made in our own works from commercial quality half-hard Aluminium. Two, three or four sided.

**SAME DAY SERVICE**

of over 20 different forms made up to YOUR SIZE. Order EXACT size you require to nearest $\frac{1}{16}$" (maximum length 35", depth 4").

*SPECIALS DEALT WITH PROMPTLY*

**SEND FOR ILLUSTRATED LEAFLET**

Or order straight away, working out total area of material required and referring to table below, which is for four-sided chassis in 18 s.w.g. (for 16 s.w.g. add $\frac{1}{8}$th)

| | | | |
|---|---|---|---|
| 48 sq. in. | 4/- | 176 sq. in. | 8/- |
| 80 sq. in. | 5/- | 208 sq. in. | 9/- |
| 112 sq. in. | 6/- | 240 sq. in. | 10/- |
| 144 sq. in. | 7/- | 272 sq. in. | 11/- |

304 sq. in. 12/-
336 sq. in. 13/-
368 sq. in. 14/-
and pro rata

**FLANGES** ($\frac{1}{4}$", $\frac{3}{8}$" or $\frac{1}{2}$") **6d.** per bend.

**STRENGTHENED CORNERS, 1/-** each corner.

**PANELS.** The same material can be supplied for panels, screens, etc. Any size up to 3ft (18 s.w.g.) at **4/6** sq. ft. (16 s.w.g. **5/3**).

**CHASSIS & PANELS FOR FEATURED RECEIVERS**

Short Wave **6/9d.** Simple All-Wave **7/9d.** "Meteor" **7/-**. All plus 3/- postage and packing.

"Nightrider", complete with louvred cabinet, blue hammer finish, **£5.5.0** post free.

(All the above are supplied undrilled)

**H. L. SMITH & CO. LTD.**

**287/289 Edgware Rd., London, W.2**

*Telephone :* PAD 5891/7595

MAXI-Q

*COMPONENTS FOR THE*

# 'NIGHTRIDER'

**COIL TURRET CT.7/B.**
This turret is the basic portion of the CT.7. It comprises cadmium plated steel frame (size $5\frac{1}{4}$" deep × $4\frac{1}{4}$" high × $3\frac{1}{2}$" wide), silver plated contacts, polystyrene insulation and rotary turret movement incorporating Aerial, Mixer and Oscillator coils for the three bands 1.5-4 Mc/s, 4-12 Mc/s and 10-30 Mc/s. ..... Price **75/-d.**
Coil strips for the long and medium wavebands may be purchased separately for incorporation in the turret. ..... Price **10/6d.** each.
The turret requires a 315pF tuning capacitor. A suitable 3 gang component with ceramic insulation is available. ..... Price **19/-d.**
Air spaced concentric trimmers 3/30pF.
Price **3/6d.** each.

**I.F. TRANSFORMER IFT.11/465 Kc/s.**
A miniature I.F. Transformer for 465 Kc/s giving excellent performance at low cost. Coils are litz wound and permeability tuned with high-grade iron dust cores and silver mica capacitors.
Screening Can $1\frac{7}{8}$" × $1\frac{3}{16}$" square. Price **6/6d.** each
Also available for 1.6 and 10.7 Mc/s.

**I.F. TRANSFORMER IFT.12/85 Kc/s.**
A narrow band 85 Kc/s I.F. Transformer for use in double superhet communications receivers. The overall response of one transformer is approximately 3.5 Kc/s at 6dB. Dynamic resistance 500,000 ohms. Wound on a polystyrene former with iron-dust core tuning and silver mica capacitors. ..... Price **16/-d.** each.
Also available for 100 Kc/s.

**BEAT FREQUENCY OSCILLATOR COIL BFO. 2/85 Kc/s.**
These compact coils are wound on a bakelite former complete with adjustable iron-dust cores and enclosed in an aluminium screening can measuring $1\frac{3}{8}$" × $1\frac{3}{16}$" sq. ..... Price **5/-d.** each.
Also available for frequencies of 100 Kc/s, 465 Kc/s and 1.6 Mc/s.

General Catalogue covering full range of components, send 1/6d. in stamps.
**Please send S.A.E. with all enquiries.**

**DENCO (Clacton) LTD.** (DEPT. SWR) 357/9 OLD RD. CLACTON-ON-SEA, ESSEX

# METALWORK

All types of

**CABINETS · CHASSIS · RACKS, etc.**

to your own specification

**PHILPOTT'S METALWORKS LTD.**

**Chapman Street, Loughborough, Leics.**



*SPECIFIED BY THE AUTHOR*

FOR THE

**BEGINNER'S SHORT WAVE RECEIVER**

*(See page 17)*

**SWQ1 - - 6/-**

**SWQ2 - - 6/-**

**OSMOR COILS** are regularly used and recommended by designers writing in "The Radio Constructor," "Practical Wireless," and "Wireless World." Why not follow the experts?

GET THESE

**FREE!**

**CIRCUITS AND WIRING DIAGRAMS**

T.R.F. Circuits
Battery Circuits
Portable Circuits
S'het Circuits
Mains Circuits
Filter Circuits
TV Converter Circuits
etc., etc.

*Please send 1/- (stamps) to cover postage, etc.*

**"Q" COILS** All ranges
**POTTED COILS**
**FM COILS**
**SPEAKER CROSS-OVER COILS**
**TAPE COILS**
**ROD AERIALS**
**SUB-MINIATURE COILS**
**COILS and I.F.s for Transistor Circuits**
**MIDGET I.F. TRANS** With ferrite cores

**OSMOR** 418 BRIGHTON RD., SOUTH CROYDON SURREY
Telephone: CRO 5148/9

# We Can Supply . . .

## ALL COMPONENTS SPECIFIED IN THIS BOOK

Valves, valveholders, resistors, potentiometers, condensers (both air-spaced and fixed values), speakers, output transformers, mains transformers, smoothing and r.f. chokes, solder, screws and nuts, p.v.c. wire, systoflex, soldering irons and a large selection of control knobs.

Comprehensive stocks of all radio components are available by return of post. If you are constructing one of the excellent receivers described herein, you cannot do better than send us a postcard for a quotation.

Write now for full Bargain Lists, enclosing 3d. stamp for reply.

*Hours 9 a.m.—6 p.m., 1 p.m. Wed.*

**TRS RADIO COMPONENT SPECIALISTS**

Est. 1946 **70 Brigstock Road, Thornton Heath, Surrey** *Telephone* THO 2188

*Terms: C.W.O. or C.O.D. Post and packing up to ½ lb. 7d., 1 lb. 1/1, 3 lb. 1/6, 5 lb. 2/–, 10 lb. 2/9*

## BUILD THIS 1-VALVE SHORT WAVE RECEIVER

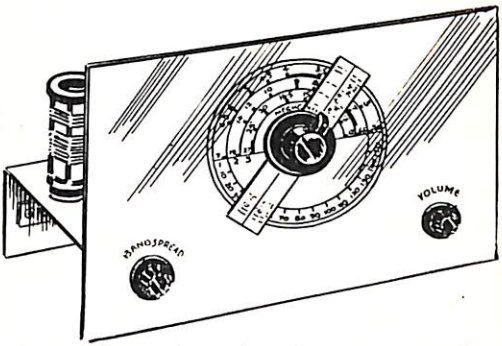
### Explore the World for 35/-

*Ideal for Beginners and Hams*

★ **All Components Colour Coded**
★ **Covers Short wave and Medium wave**
★ **Sharp Tuning**
★ **World wide Reception**

An easy to build Short Wave Receiver at a very low price. Pulls in thrilling Short Wave foreign broadcasts, Amateur and Aircraft, etc., as well as standard Medium Wave transmissions. Bandspread for easy Short Wave tuning.

**Send for Parts, Price List and easy Layout Plans ... ... 2/**




Conversion price includes valve and one coil covering 40–100 m. ● Can be converted to 2V or 3V. ● Receives speech and music clearly from all over the world.

**Extra Components**

| | | | |
|---|---|---|---|
| 1-2V Conversions including Valve | ... ... 7/6 | Power Pack, Type PU 1 for mains operation ... | 32/6 |
| 2-3V | ... ... 10/– | Speaker and Transformer ... ... | 25/– |
| Cabinet | ... ... 10/– | Extra Coils ... | 4/– each |

**R.C.S. PRODUCTS (Radio) Ltd., 11 OLIVER RD., LONDON, E.17**

*Trade Enquiries Welcomed* *Mail Order Only*

# THE MODERN BOOK CO

**The Radio Amateur's Handbook, 1963.** By A.R.R.L. **36/-d.,** postage 2/6d.

**The A.R.R.L. Antenna Book 18/-d.** postage 1/6d.

**Servicing Transistor Radios and Printed Circuits.** By L. Lane. **42/-d.** postage 1/-d.

**Handbook for Radio Operators.** By H.M.S.O. **6/-d.,** postage 1/-.

**The All In One Tape Recorder Book.** By J. M. Lloyd. **12/6d.,** postage 9d.

**Transistor Radios Circuitry and Servicing.** By Mullard. **5/-d.,** postage 6d.

**More About Loudspeakers.** By G. A. Briggs, 1963. **8/6.,** postage 1/-d.

**T.V. Fault Finding.** A Data Pub. **7/6d.,** postage 6d.

**Service Valve Equivalents.** An R.S.G.B. Pub. **3/-d.,** postage 6d.

**Radio Valve Data** 7th ed. Compiled by "WW". **6/-d.,** postage 1/-d.

**Basic Electricity.** Complete vol. A Common Core Book. **68/-d.,** postage 2/-d.

**The Amateur Radio Handbook.** An R.S.G.B. Pub. **34/-d.,** postage 2/-d.

**Electronic Musical Instrument Handbook.** By N. H. Crowhurst. **20/-d.,** postage 1/3d.

**Single Sideband Communications Handbook.** By H. D. Hooton. **56/-d.,** postage 1/3d.

**World Radio T.V. Handbook.** 1963 ed. **22/-d.,** postage 1/-d.

**Radio Control for Models.** By F. C. Judd. **15/-d.,** postage 1/-d.

**Television Engineers' Pocket Book.** By J. P. Hawker. **12/6d.,** postage 8d.

**Principles of Colour Television.** By G. N. Patchett. **16/-d.,** postage 8d.

**Circuits for Audio Amplifiers.** By Mullard. **8/6d.,** postage 1/-d.

**Radio & Television Test Instruments.** By G. J. King. **25/-d.,** postage 1/6d.

**Cabinet Making.** By W. Smith. **7/6d.,** postage 9d.

**A Guide to Amateur Radio.** An R.S.G.B. Pub. **5/-d.,** postage 6d.

**Basic Electronics.** Complete vol. **80/-d.** A Common Core Book, Postage 2/-d.

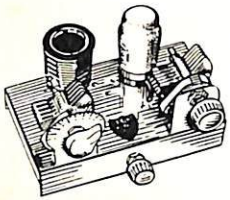
WE HAVE THE FINEST SELECTION OF BRITISH AND AMERICAN RADIO BOOKS IN THE COUNTRY

*COMPLETE CATALOGUE 1/-*

**19-21 PRAED STREET (DEPT SH) LONDON W2**

*Telephone* PADdington 4185

# HOME RADIO OF MITCHAM



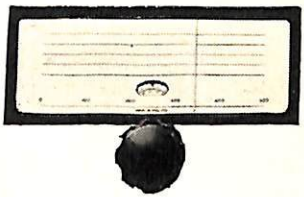
ARE THE

## Short-Wave Radio Specialists

*All parts in stock for all the designs described in this book and detailed price lists available on request mentioning the particular model required.*

*FULL RANGE OF*

EDDYSTONE



SHORT-WAVE COMPONENTS AND DIALS ALWAYS IN STOCK

**DENCO, OSMOR, TELETRON COILS and CHOKES**

•

**JACKSON BROS. CONDENSERS**

•

**ELLISON TRANSFORMERS**

**Also HEADPHONES, BATTERIES, AERIALS, etc.**

## HOME RADIO OF MITCHAM

**187 LONDON ROAD** **MITCHAM, SURREY**

*Shop hours 9–6.30 (Wed. 1.0 p.m.)* MIT 3282


A. Quick & Co. (Printers) Ltd. Oxford Road Clacton-on-Sea Essex England